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Petrochemical Process Handbook

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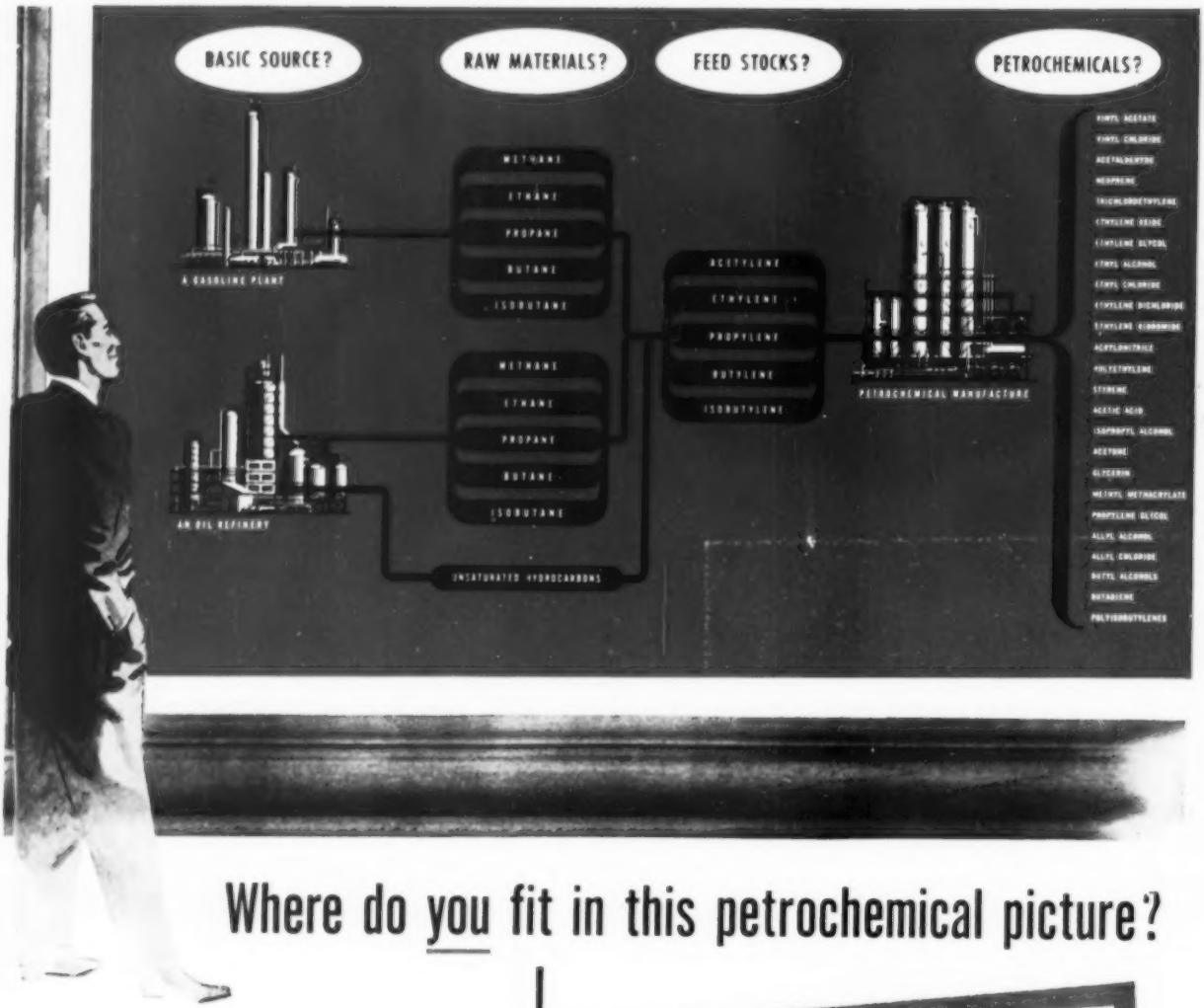

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Currently engaged in this highly specialized work, Fluor can help determine your potentials in this rapidly expanding industry.

Petrochemicals, the largest new factor in our ever-expanding world of chemicals, now account for nearly one-quarter of all U. S. chemical production. Despite this, it is estimated that only one-half of one percent of all present oil and gas production is being utilized as petrochemical feed stock. This opens up new opportunities for the oil and gas producer and investor.

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Volume 32, No. 11 November, 1953

PETROLEUM
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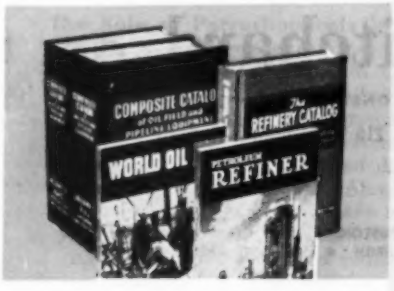
Single copies $1 for this special issue for U. S. and Canada; $1 for all other countries. Subscription rates—U. S. and Canada $2 a year; Latin America and overseas $5 a year. PETROLEUM REFINER, published on the 16th of every month, entered as second class matter June 16, 1923, at the post office at Houston, Texas, under act March 3, 1879. Advertising rates on application. Copyright 1953 by The Gulf Publishing Company.

Petroleum Refiner is Indexed by Industrial Arts Index, Chemical Abstracts and by Engineering Index, Inc. Microfilm copies available through University Microfilms, Ann Arbor, Michigan.



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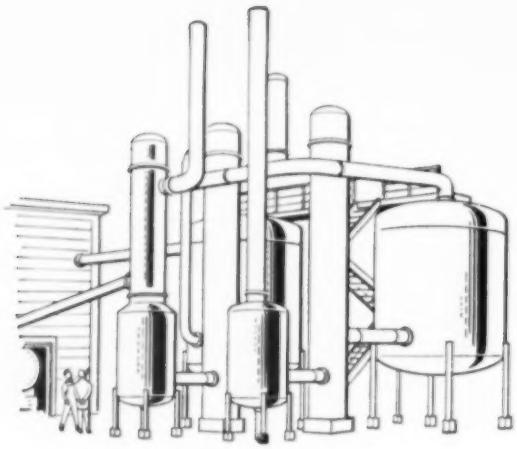

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A Quick Look at This Month's

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Executive Training—Your Neglected Problem? . . . Companies, like trees, die from the top. Your firm is expanding today under the sure hand of aggressive, capable leadership. But what of tomorrow? Do you have a trained reservoir of executive talent? If so, your company is an exception. You can well afford to spare a few minutes today to be warned of tomorrow's problems. **Page 93.**

What's Ahead for Petrochemicals? . . . In answer to the question posed by the title of this feature, we have the opinion of some of the top men in the petrochemical industry. These men, all in positions of authority in their respective companies, are qualified to make an industry-wide forecast for the coming twelve months. To read what they think about the future of the industry, turn to **Page 100.**

The Petrochemical Industry . . . This is a complete study of the petrochemical industry—past, present and future. Total production figures and the position of petrochemicals in relation to the entire chemical industry are presented. The basic processes used to bring the industry to its present size and the companies responsible for developing and putting the processes into commercial operation are discussed. This article also gives an insight into the factors behind the tremendous expansion of this relatively new industry. **Page 104.**

The Role of Petrochemicals in SYNTHETIC DETERGENTS . . . The petrochemical product dominates the synthetic detergent field. In this article, Dr. Foster D. Snell, a well known authority on synthetic detergents, points out that its share of the market has increased from 49 percent in 1949 to 65 percent in 1952. This increase has occurred in an industry where total production increased from 250 million pounds in 1950 to an estimate of almost two billion pounds this year. For additional market data and for information on new trends in this field turn to **Page 108.**

The Role of Petrochemicals in SNYTHETIC RUBBER . . . This industry is of vast importance to the petrochemical field because it consumes almost 20 percent of all petrochemical production on a tonnage basis. Although the industry came into its present position as a result of the need to fill shortages brought on by the last war, its peacetime production has been maintained at a high level. It has had a tremendous stabilizing effect on the price of rubber goods in this country. For an interesting article on markets, future production and new developments, read this article by Mr. Ruebensaal. **Page 110.**

The Role of Petrochemicals in FERTILIZERS . . . Production of synthetic nitrogen has increased tremendously in recent years to fill the demands for fertilizers. The industry's production was only a fraction of the total nitrogen produced in 1940, but it now amounts to about 90 percent. This increase has been marked by the continued development of processes utilizing natural gas. About 60 percent of all synthetic nitrogen is now made using natural gas as the basic raw material. This article gives production figures for past years and estimates for the future. The effect on the industry of large scale production of urea for fertilizer use is also covered. See **Page 112.**

The Role of Petrochemicals in SYNTHETIC FIBERS . . . Here is an industry that is growing at a rapid rate. Last year its production amounted to 4 percent of the total fiber requirements of this country. Many of these fibers are based on petrochemical products. This article not only gives production figures and analyzes the possible future growth, but gives a clear insight into the entire synthetic fiber picture. **Page 114.**

The Role of Petrochemicals in PLASTICS AND RESINS . . . Petrochemicals are consumed by this industry to the extent that the present rate of production of the major petrochemical based plastics and resins is greater than one billion pounds. The use of petrochemicals has come about as the result of the development of a synthetic plastics industry as opposed to an industry based on naural plastics. In addition, petrochemicals are now replacing some of the chemicals formerly obtained from other sources. This article also covers the use of plastics and resins as applied to the petrochemical and oil industries. For further details, see **Page 116.**

The Role of Petrochemicals in PESTICIDES . . . The use of petrochemicals in the pesticides industry for the agricultural market is given a frank appraisal in this article. The author traces the development of this industry and discusses the possibilities of the increased utilization of petrochemicals in this field. **Page 117.**

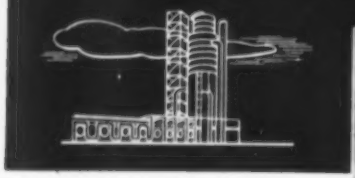
Live Executives Are Best! . . . You owe it to yourself, your company, your industry and your country to keep healthy. ". . . the physical as well as the mental health of those responsible for directing our industrial machinery may have a profound effect on its success or failure," declares the author, Dr. George M. Saunders, medical director of Socony-Vacuum Oil Company, Inc. For some vital tips on how to be healthy though successful, see **Page 287.**

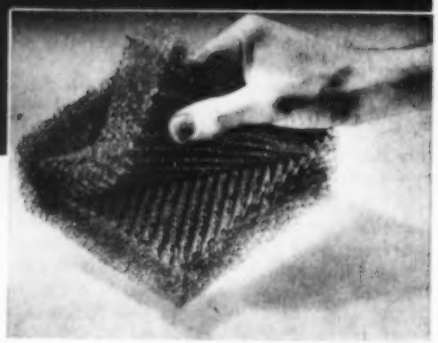
You're Fired! . . . You don't, of course, use such harsh language in dismissing an employe. But regardless of the language you use—whether it be discharge, terminate or release—the act will entail a lasting heartache unless you use a planned approach. For some helpful hints on a painful problem, see **Page 296.**

IS LIQUID CARRY OVER–

. . . Limiting Your Production?
. . . Affecting Product Purity?
. . . Cutting Into Your Profits?

IF SO–GET THE FACTS ON METEX MIST ELIMINATORS!





Section of a METEX MIST ELIMINATOR, opened to show construction. They can be made of practically any metal, to combat corrosion. Factory cut to fit vessel dimensions and contour, there is no limit to the size in which they can be obtained.

Liquid entrainment need no longer be considered an unavoidable nuisance in processing operations, as more and more engineers are finding from experience. These *knitted* wire mesh entrainment separators literally "filter out" the entrainment (see diagram) and permit the gas to pass on, freed from the unwanted–and often contaminating–liquid.

METEX MIST ELIMINATORS can be easily installed in new or existing vessels. They require no special housings, equipment or power–and need no servicing or attention. They function over a wide range of velocities with a pressure drop usually so low it cannot be measured. Users report efficiencies of 99% and more.

METEX Mist Eliminators can be used wherever the problem of liquid entrainment exists. By effecting complete removal of liquids, Mist Eliminators contribute to more efficient and economical processing in such vessels as:

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- **KNOCK-OUT DRUMS**
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- **ABSORBERS**
- **SCRUBBERS**
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When a gas is generated in or passes through a liquid (1), it carries with it on leaving the surface (2), droplets of entrained liquid. These droplets are carried upward by the rising gas stream (3). As the gas continually changes direction in passing through the pad, the droplets are impinged on the extensive wire surface. Here the droplets coalesce, forming large drops of liquid which break away (4) from the pad and fall back through the gas stream. The gas (5) passes on, freed from liquid entrainment.

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CATALYST CONTAMINATION CURED BY REMOVING ENTRAINMENT IN DISTILLATION UNIT

Equipment Costing $15,000 Pays Out In Under A Week For Large Southwestern Refinery

It was not a difficult problem to trace the cause of mounting catalyst losses to a cat unit feed so poor in color that it was essentially black. Entrainment of liquid from the bottom of the still column could be the only answer.

Here was a situation where a Metex Mist Eliminator would remove the entrainment – but what else might happen? Would this knitted wire mesh separator cause excessive pressure drop? How quickly would it become plugged by coke deposits and make the column inoperable?

Calculations by one engineer showed that the total cost of installing a 25-ft diameter Mist Eliminator, including designing and erecting supports within the still, was approximately $15,000 – less than a week's catalyst loss. After considerable study the decision was made, and the Mist Eliminator installed during the next routine turnaround.

When the first run of cat unit feed came from the remodeled crude distillation unit, it was crystal clear and water white. Throughout the normal run no differential pressure across the screen was found.

The problem was solved. Catalyst losses dropped sharply. And the Mist Eliminator has paid for itself in a matter of days.

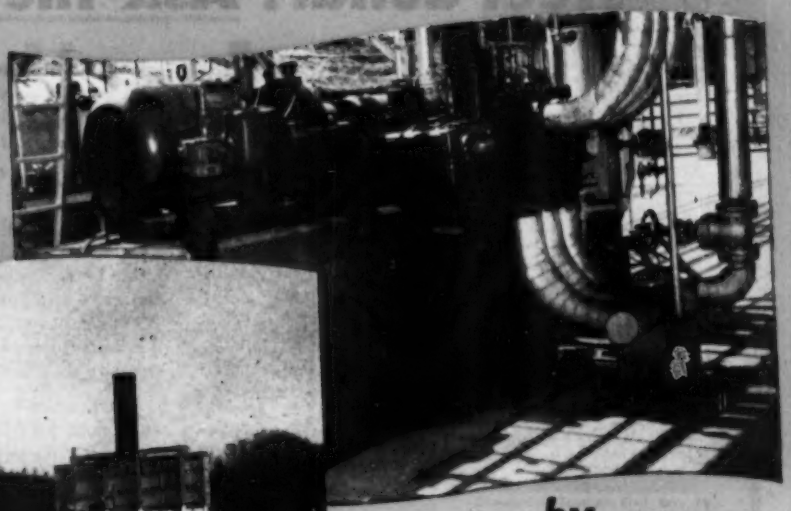
Have you really analyzed your entrainment costs, and checked the savings a Mist Eliminator could make for you? Perhaps you are losing valuable end products in the exhaust stream. Perhaps you have a nuisance contamination problem. Perhaps the entrainment created in one vessel is causing trouble in a subsequent operation. For entrainment is an inevitable result of most processing and refining operations.

Metex Mist Eliminators perform just one function–and they are doing it in more and more refining vessels every day. They remove liquid entrainment–efficiently and economically–wherever it may occur.

Why not write today for more information on Metex Mist Eliminators. Or better yet, send data on your particular entrainment problem. We'll be glad to have our engineers check this, and send you our recommendations and suggestions. (Adv.)

Another Wilson-Snyder Triplex Pump

. . . was selected for Reactor Charge Service in another "Platforming" Unit



by Elk Refining Company, Falling Rock, West Virginia

The Following Table

. . . presents a quick look at the performance range for six-inch stroke Triplex Plunger Pump:

Plunger Size, Inches	Maximum Working Pressure, psi	Displacement				
		Gallons Per Minute at Pump Speeds (rpm) of:				
		60	80	100	120	140
2	2800	15	20	25	30	35
2¼	2510	19	25	31	37	43
2½	2040	23	30	38	46	54
2¾	1680	28	37	46	56	65
3	1420	33	44	55	66	77
3½	1040	45	60	75	90	105
4	795	59	78	98	117	137
4½	630	74	99	124	149	174
Actual Brake Horsepower Required		32	43	54	64	75

Triplex Plunger Pumps also available in 4" and 8" stroke sizes.

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MORE AND MORE refinery men are specifying Wilson-Snyder Triplex Plunger Pumps. These compact, sturdy, positive-displacement pumps are being selected for high pressure process charge service in new construction, expansion and modernization programs by major and independent refiners everywhere.

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. . . a horizontal six-inch stroke triplex pump, with direct electric-motor drive through a speed reducer, is used for reactor charge service in another Procon built, UOP platforming unit which went on stream November 11, 1952.

The capacity of this unit is 1,500 barrels per day and the gasoline produced has octane ratings well into the 90's. Naptha reforming charge stock at approximately 300°F. is pumped at approximately 750 psi, with 900 psi maximum, for this operation.

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Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

** Available as seamless tubing on an experimental basis only.*
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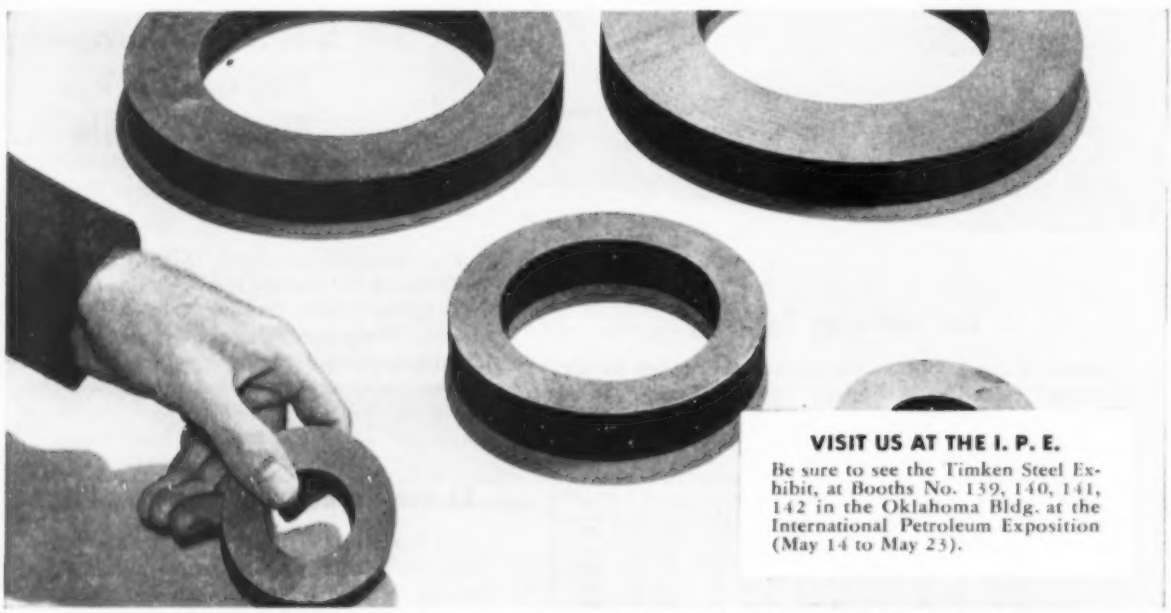
Let Timken's "RSQ"—Research, Supply, Quality—solve your tube problems. *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".



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ALLIS-CHALMERS

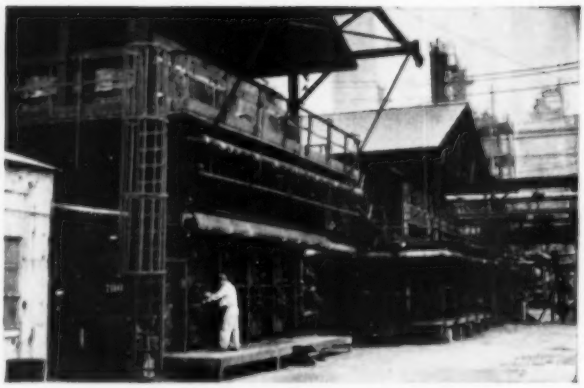
Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Distributors, Certified Service Shops and Sales Offices throughout the country.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

PUMPS — Integral types from ¾ in. to 72 in. discharge and up.



Typical plants where L&N oxygen recording equipment keeps total oxygen completely and accurately recorded, for more efficient combustion control.

Left: A steam central station (boiler furnace in rear) in an eastern utility. Right: A process heater in an eastern oil refinery.

NEW PERFORMANCE for COMBUSTION EQUIPMENT

with the L&N Magnetic Oxygen Analyzer

● Rugged, stable and precise, this unique analyzer detects the percentage of oxygen in flue gas from boiler furnaces and process heaters in oil refineries. Since oxygen is the most reliable index of excess air, especially when firing with mixed fuels, these desirable advantages are now made possible:

(1) combustion efficiency goes up (2) fuel costs go down, and (3) maintenance time is cut to the barest minimum.

To triply assure you of best results, Leeds and Northrup has teamed up this advanced instrument with the Speedomax[®] Recorder and a sampling unit experience-engineered for reliable operation. This efficient combination offers you this warranted and superior performance:

- **Calibrated Accuracy:** ± 0.15% oxygen against standard gas mixtures
- **Sensitivity:** Better than ± 0.05% oxygen
- **Stability:** Better than ± 0.15% oxygen
- **Speed of Response:** Initial—8 to 12 seconds; 90% of final reading—35 seconds

To revitalize your fuel-burning efficiency, remember that *L&N oxygen* equipment gives you . . . a rapid response to oxygen for *"tight" combustion control* . . . an accurate check on air with *no need for tank samples* . . . the most practical answer to *continuous, trouble-free operation.*

For further information, write to Leeds & Northrup Company, 4923 Stenton Avenue, Philadelphia 44, Pa.

LEEDS NORTHRUP
instruments automatic controls • furnaces

Jrl. Ad ND46-91(3)

HELP NEW Cracking Methods

ALLIS-CHALMERS Centrifugal Blowers

LEFT: Catalyst lift air blower supplies air at 13,320 cfm, 4.25 psig to raise regenerated catalyst to reactor. Kiln combustion air blower is seen to the rear.

ABOVE: Carbon is burned off the catalyst while air is supplied at 34,400 cfm, 3.5 psig by this kiln combustion air centrifugal blower.

AS CRACKING METHODS IMPROVE, more centrifugal blowers are being employed. The Allis-Chalmers single stage blowers seen here are essential to the three new Thermofor Catalytic Cracking units installed by the Magnolia Petroleum Co. at Beaumont, Texas.

A total of six turbine-driven A-C single stage blowers provide kiln combustion and catalyst lift air in the blower room of the new catalytic structure.

The high efficiency impellers are of special totally enclosed, backward flow design. This covered design makes the impellers independent of tolerance variations; the backward flow design gives good pressure, volume and horsepower characteristics.

High strength and long life is assured by all-welded, alloy steel impeller construction and pressure lubricated sleeve and thrust bearings. Cast iron casing increases rigidity and decreases noise level.

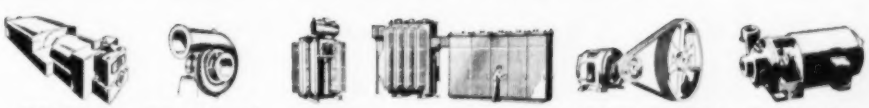
For this kind of specialized design . . . or for standard high quality, thoroughly tested air and gas handling equipment . . . call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wis.

A-3999

Texrope is an Allis-Chalmers trademark.

ALLIS-CHALMERS

Power, Electrical, Processing Equipment for Petroleum Industry



TURBINE-GENERATORS | BLOWERS and COMPRESSORS | TRANSFORMERS | UNIT SUBSTATIONS | MOTORS—*TEXROPE* DRIVES-CONTROL | CENTRIFUGAL PUMPS

WHAT'S NEW AT BRISTOL . . . . WHAT'S NEW AT BRISTOL

Meet the WORLD'S SIMPLEST INSTRUMENT SYSTEM!

It's Bristol's new METAGRAPHIC pneumatic transmission instrument system, for measuring, indicating, recording and controlling pressure, temperature, vacuum, flow, differential pressure and liquid level.

HERE ARE THE BIG ADVANTAGES OF THE NEW METAGRAPHIC SYSTEM:

1. SIMPLICITY – fewer parts, fewer adjustments, and less service required. Range changes can be made in seconds.

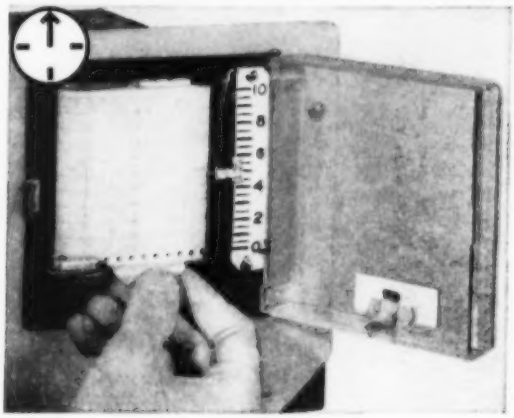
2. FLEXIBILITY – units can be combined like building blocks to make any kind of arrangement.

3. TRUE PLUG-IN SERVICE—results in great savings in installation costs; units can be plugged in or out without stopping process or control.

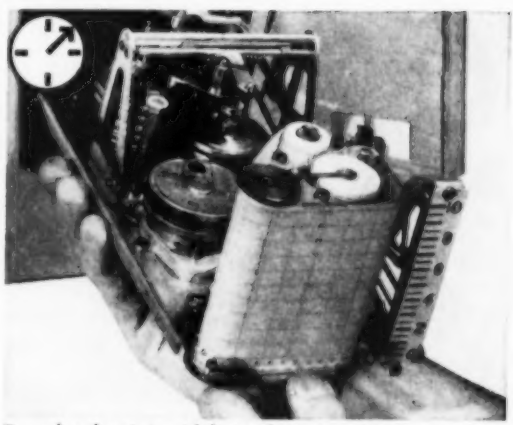
4. NO TIME LAGS—in a four-pipe circuit the transmitter signal and controller-output signal travel around a short loop—as small as three feet.

Get the whole METAGRAPHIC story by writing to The Bristol Company, 111 Bristol Road, Waterbury 20, Conn.

***It takes only fifteen seconds to* change the Bristol METAGRAPHIC recorder to an indicator!**



Case door is opened.



Recorder chassis is withdrawn from case. Air pressure is automatically maintained.

Indicator chassis is plugged into same case.

LOOK FOR OUTSTANDING NEW DEVELOPMENTS FROM BRISTOL.

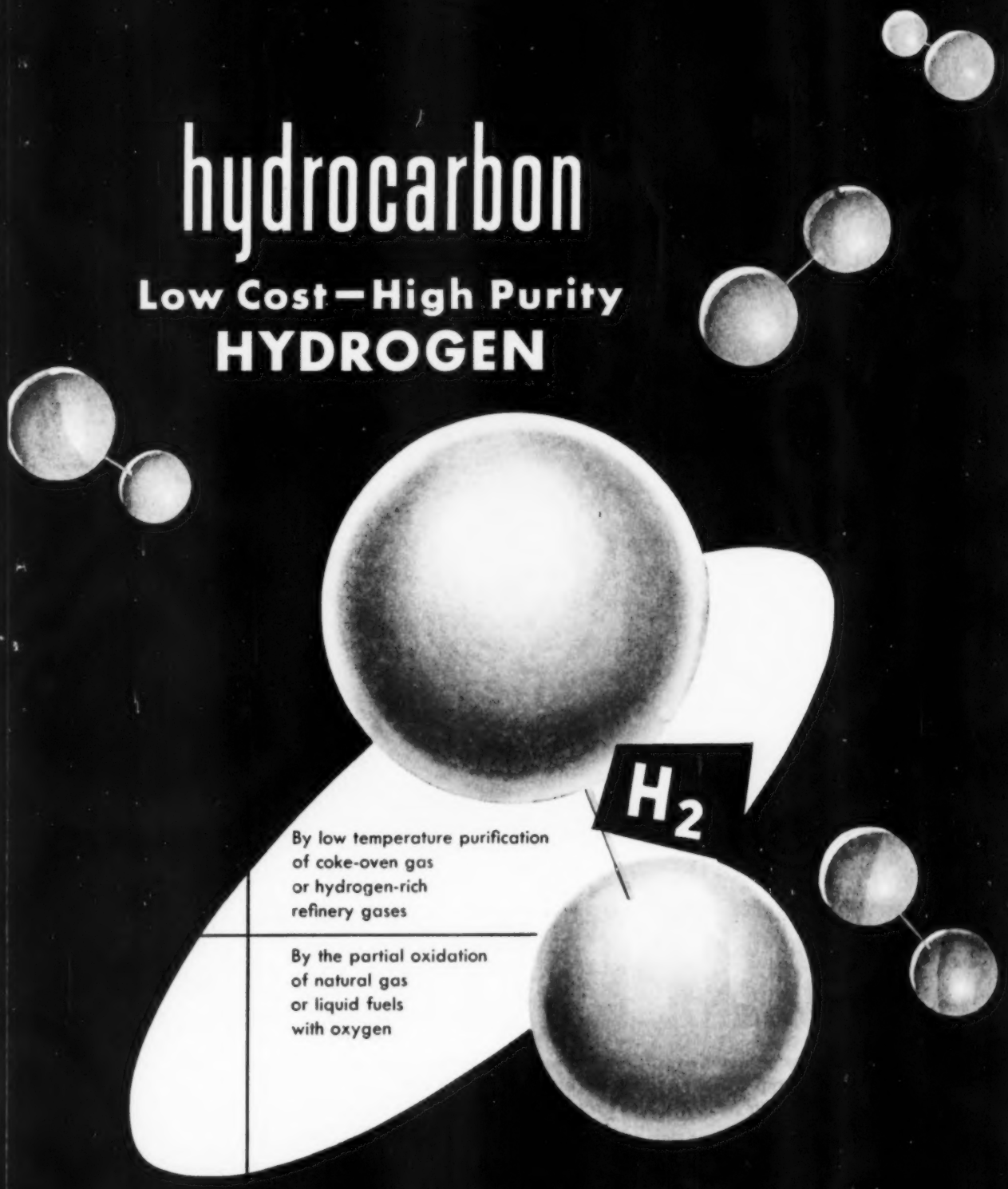
BRISTOL

THE DEPENDABLE GUIDEPOST OF INDUSTRY

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

hydrocarbon

Low Cost—High Purity HYDROGEN



By low temperature purification of coke-oven gas or hydrogen-rich refinery gases

By the partial oxidation of natural gas or liquid fuels with oxygen

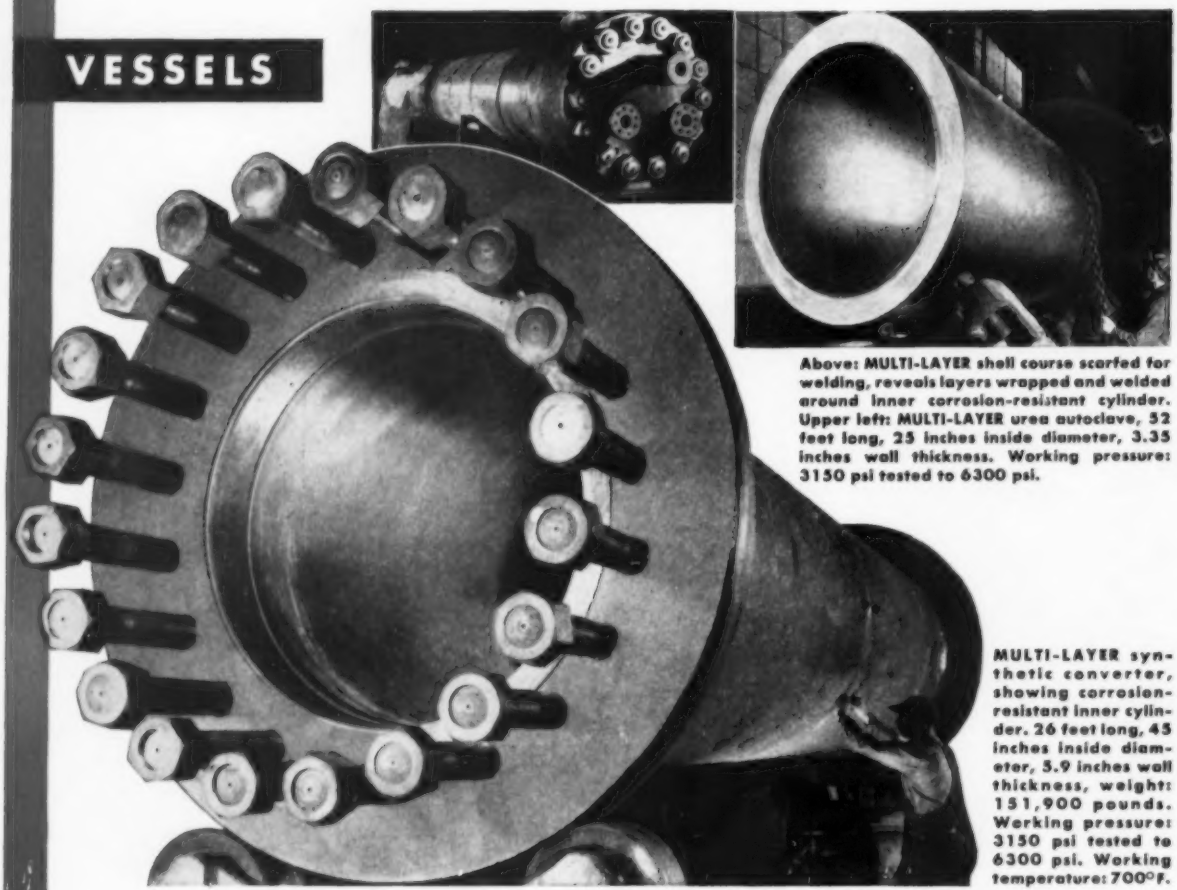
HYDROCARBON RESEARCH, INC.
115 Broadway, New York 6, N. Y.
Cable: Hydrocol

HRI
petroleum and chemical processing for profit

TRENTON, NEW JERSEY—Hydrocarbon Research, Inc., Development Laboratory, P. O. Box 1419.
PARIS, FRANCE—Hydrocarbon Engineering, S.a.r.L. 44, Avenue des Champs-Elysées, Cable: Hydrocarbon.
DUESSELDORF, GERMANY—Hydrocarbon Mineraloel, G.m.b.H., 15-17 Fuerstenwall. Cable: Hydromin.
RIO DE JANEIRO, BRAZIL—General Heitor Pedroso, Rua da Quintanda, 20, Sala 801. Cable: Bispetro.
NEW DELHI, INDIA—A. R. Palit & Company, Sujan Singh Park, Post Box 671, Cable: Palitar

A.O.Smith for

VESSELS



Above: MULTI-LAYER shell course scarfed for welding, reveals layers wrapped and welded around inner corrosion-resistant cylinder. Upper left: MULTI-LAYER urea autoclave, 52 feet long, 25 inches inside diameter, 3.35 inches wall thickness. Working pressure: 3150 psi tested to 6300 psi.

MULTI-LAYER synthetic converter, showing corrosion-resistant inner cylinder. 26 feet long, 45 inches inside diameter, 5.9 inches wall thickness, weight: 151,900 pounds. Working pressure: 3150 psi tested to 6300 psi. Working temperature: 700°F.

MULTI-LAYER MEETS

The designer's answer to higher pressures, temperatures, and more critical corrosion problems . . . *with safety*

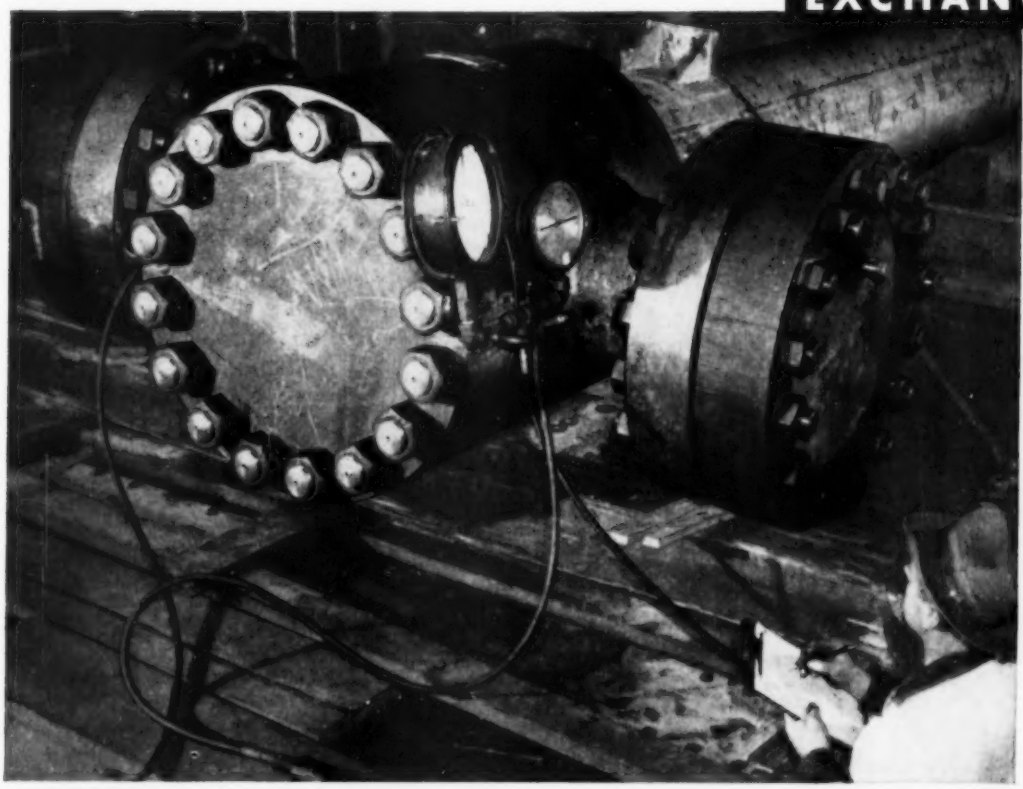
As processing problems become more acute, A. O. Smith MULTI-LAYER construction of vessels and heat exchanger shells becomes more and more important to equipment designers and buyers.

Future requirements of processors are being solved with this time-tested design. MULTI-LAYER inherently satisfies all of the conditions of modern operation: extreme pressures, elevated temperatures, critical corrosion conditions.

Because MULTI-LAYER construction consists of wrapping and welding successive concentric layers of relatively thin steel plate around a central, pressure-tight cylinder, no size or weight limitations are imposed, making it possible to design the vessel to fit the requirements of the process. Since the inner cylinder is pressure-tight, load-bearing layers are provided with vent holes to prevent damage from over pressure and to serve as automatic safety and warning devices in the remote event of

Outstanding Advantages

EXCHANGERS



Inter cooler (heat exchanger) with U-tube construction, being tested before shipment. Operating pressure: 2500 psi.

CHALLENGE of FUTURE

runaway overload. In applications, involving hydrogenation, venting prevents embrittling attack on the load-bearing layers. For corrosive service, the inner cylinder is fabricated of lined or clad plate, alloy steel or non-ferrous material to meet the processing condition.

Bigger batches to effect economies and meet competition in an expanding market can be planned. Advanced processing methods can be implemented. Our own designers, engineers, and research staff will welcome opportunities to assist in adapting MULTI-LAYER vessels and heat exchangers to your needs.

Send for MULTI-LAYER Bulletins: V-52, *MULTI-LAYER Manufacturing and Assembling*, and V-53, *MULTI-LAYER Engineering for Safety.*

A.O.Smith
CORPORATION

Vessels and Heat Exchangers
MILWAUKEE • HOUSTON
Licensee in Canada: John Inglis Co., Ltd., Toronto
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RIGHT IN THE HEAT OF THINGS

in Power Plants

. . . you'll find economy-minded B-L boiler enclosures in power plants all over the country. Size poses no problem: B-L engineers them all from small HRT settings to huge 10-story jobs like the one illustrated.

in Chemical Plants

. . . Bigelow dryer furnaces deliver a tremendous volume of hot gases—as much as 93,000,000 BTU's—at predetermined temperatures to rotary dryers. Furnaces process coal, sugar, salts, grain—any product from which moisture must be removed.

in Oil Refineries

. . . B-L offers a complete, one-source service of engineering, materials, and erection help for castable regenerators and pressure vessels of all kinds. Construction can be either castable, tile or a combination of the two.

yes, and in the metal, glass, cement and sugar industries (others, too!) B-L enclosures are right *in the heat of things*. Write today for complete information.

BIGELOW-LIPTAK *Corporation*

and Bigelow-Liptak Export Corporation

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UNIT-SUSPENDED WALLS AND ARCHES

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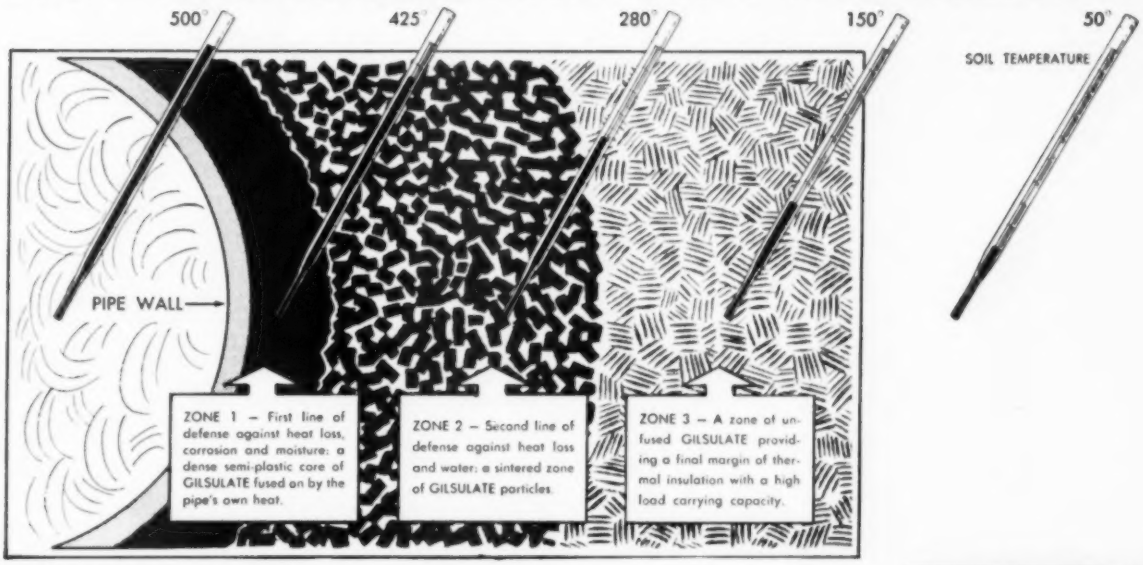
Lowest Cost

PER INSTALLED LINEAR FOOT OF ANY HOT UNDERGROUND PIPE INSULATION


500°
425°
280°
150°
50°
SOIL TEMPERATURE
PIPE WALL
ZONE 1 – First line of defense against heat loss, corrosion and moisture; a dense semi-plastic core of GILSULATE fused on by the pipe's own heat.
ZONE 2 – Second line of defense against heat loss and water; a sintered zone of GILSULATE particles.
ZONE 3 – A zone of unfused GILSULATE providing a final margin of thermal insulation with a high load carrying capacity.

GILSULATE®... the triple-zone insulation that fuses itself into lifetime protection for hot underground pipes. Water-proof, corrosion-proof, root-proof, acid/alkali-proof.

Compare your present insulation methods with Gilsulation:

1. Pour Gilsulate granules out of the bag onto the pipe; tamp it down.
2. Backfill: *the job is insulated!*

Gilsulate—nature's own insulation—is a unique, solidified hydrocarbon that virtually installs itself. Normal pipe-heat (up to 520° F) does the rest—fuses the Gilsulate to the pipe in hours, forming a massive circular solidified sheath.

Gilsulate costs less installed per linear foot *than any other underground pipe insulation*... it's easiest to use... and has been tested in scores of the country's largest and most important installations.

Some additional Gilsulate advantages:

- *3 grades available*—220° to 520° F
- *needs no sleeves* or mechanical sheaths
- *requires no mixing* or special handling
- *can't be punctured* – leave rocks in backfill
- *pipe expands and contracts* within Gilsulate structure
- *proved in actual use* in hundreds of new construction and replacement installations

Send coupon for descriptive literature.

AMERICAN GILSONITE COMPANY
SALT LAKE CITY, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California

No skills necessary—simply pour Gilsulate out of 100 pound bags, tamp and backfill. Can be used under any and all conditions—no matter how many pipes, whatever the space.

GILSULATE®

THE TRIPLE-ZONE INSULATION
FOR LIFETIME PROTECTION
OF HOT UNDERGROUND PIPES.

American Gilsonite Company
248 South Main Street, Salt Lake City 1, Utah
or 1145 East Jersey Street, Elizabeth 4, N. J.

Please send me descriptive literature on Gilsulate.

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....

PR

PELLETS.
Sizes: From 1/8" x 1/8" to 1/2" x 1/2".

RINGS. *Sizes:* From 3/32" I.D. x 3/16" long x 7/32" O.D. to 1/2" I.D. x 1" long x 1" O.D.

Rx for shorter contact time!

SPHERES.
Diameters: 1/4" to 1".

Norton specially engineered carriers bring proved advantages to a wide range of processes

Whatever your specific application may be, it will pay you to investigate the many advantages of Norton catalyst carriers.

Made of ALUNDUM* (fused alpha alumina), these highly refractory carriers are outstanding for heat conductivity, chemical inertness, mechanical strength and abrasion-resistance. And Norton's exclusive *controlled structure* process offers you a choice of porosities. In pellets and rings, porosities range from medium to high. In spheres, porosities range from medium, with rough exterior for coating with catalyst... to high, with a network of open pores and rough exterior for impregnating with catalyst.

Chemical engineers are finding this Norton "Special Refractory Prescription" invaluable in processing many different products. For example, in meeting the rapidly growing demand for phthalic anhydride, Norton catalyst carriers aid in shortening catalyst contact time and in achieving the highly exothermic reaction in fixed bed converters.

Test Them Out

Find out just what Norton ALUNDUM catalyst carriers can do for you. See your Norton Representative for samples, or write to NORTON COMPANY, 470 New Bond Street, Worcester 6, Mass.

Canadian Representative: A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON

Special REFRACTORIES

Making better products... to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

Because the oil industry rarely receives full credit for its share in the development of automotive transportation, Ethyl is publishing this special advertisement in the Fiftieth Anniversary issue of "Motor" magazine.

Why is automotive progress like a man washing his hands?

Did you ever try to wash *one* hand? You know it's all but impossible. As the old saying goes, "one hand washes the other."

Improving transportation is also a two-handed affair. One "hand" is the automotive industry. The other is the petroleum industry. Again and again, progress in one has been made practical by a complementary development in the other.

For example, it was the proved ability of the oil industry to provide high octane fuels, through improved refining methods and the use of "Ethyl" antiknock compounds, that prepared the way for higher compression engines. And to prove

(Continued on next page)

ETHYL
ETHYL CORPORATION

Printed in U.S.A.

Why is automotive progress like a man washing his hands?

(*Continued from preceding page*)

that it works both ways, the engineering genius of the automobile industry took full advantage of better gasolines to produce more and more efficient engines.

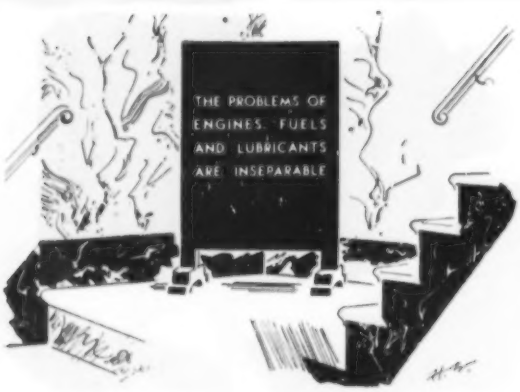
Ethyl people, recognizing this interdependence between engines and fuels, have made it the keynote of Ethyl's research and cooperative projects for the past 30 years.

We hesitate to predict what future progress will bring, but one thing is certain —that this progress will be the result of two of America's greatest industries working hand in hand. And Ethyl research people will continue to work with both industries and to serve in a very special way as liaison between them on problems of fuels and engines.

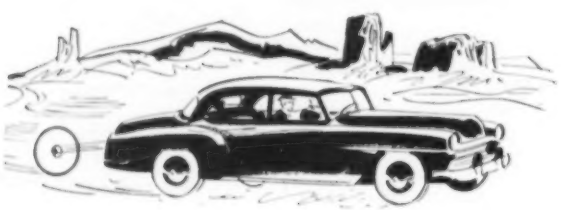
ETHYL CORPORATION

NEW YORK 17, NEW YORK

WORTH NOTING



These words are inscribed at the main entrance of the Ethyl Research Laboratories in Detroit.



Every year Ethyl buys a representative group of new cars in order to give the petroleum industry full information as to the octane requirements of these cars.

While still a young man, Thomas E. Midgley, one of America's greatest chemists, discovered the use of tetraethyllead as an antiknock agent and so became one of the chief architects of today's automotive progress!

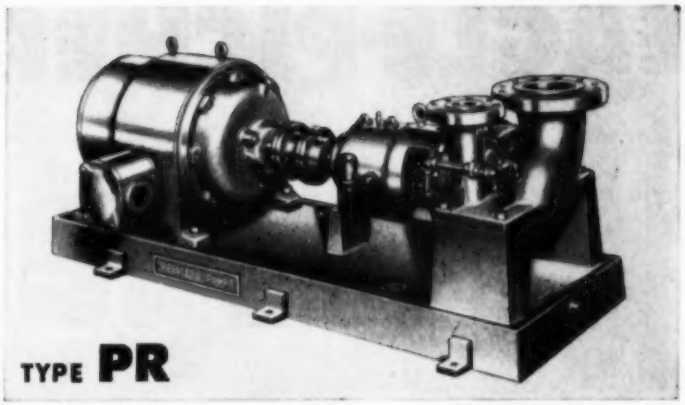
Ethyl Service is backed by 30 years of antiknock experience

designs

TO SUIT THE APPLICATION

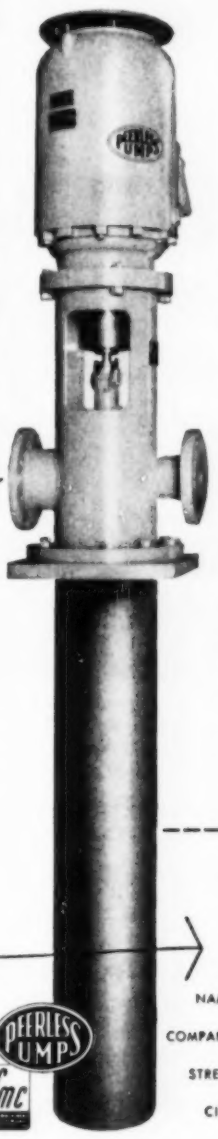
VERTICAL

HORIZONTAL



TYPE **PR**

PEERLESS PUMPS



like **THE PEERLESS HYDRO-LINE** **A HIGH PRESSURE, MEDIUM CAPACITY, BOOSTING AND CIRCULATING PUMP.** Packing gland or mechanical shaft seal construction available. Especially suited to condensate return service and for handling hydrocarbons, hot or cold water and mild salt solutions at temperatures from 0°F to 400°F. This encased, close-coupled, vertical, turbine pump is ideal for limited NPSH application in field and refinery service and for installations where space is at a premium. Its construction flexibility ideally suits it to future as well as present system needs. Easiest to install, operate and maintain. Use coupon below for Bulletin No. B-592 which describes construction details and operating characteristics.

like **THE PEERLESS TYPE PR** **A HIGH TEMPERATURE, HIGH PRESSURE PROCESS PUMP.** Packing gland or mechanical shaft seal construction available for handling hydrocarbons, water and chemical solutions at high temperatures and pressures. Designed with more than a score of engineered features that add up to real process pump superiority. Here are a few advantages: maximum parts interchangeability, extra low NPSH requirements, availability in various alloys, end or top suction design, complete range of sizes. Use the coupon below for Bulletin No. B-1605 which describes construction details and operating characteristics.

SELECT YOUR PUMP FROM THE COMPLETE PEERLESS LINE

A pump for every purpose is more than a Peerless slogan, it's a Peerless fact. Whether your requirements call for a vertical pump or a horizontal pump, Peerless can furnish the pump to meet your specifications from its complete line. You can choose from scores of Peerless types, hundreds of Peerless models for thousands of pumping applications. Peerless service is nationwide. Call the office nearest you for a Peerless field engineer. He can help you buy and apply the right pump from Peerless' comprehensive and complete line.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Address inquiries to Factories at:
Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York, Chicago, St. Louis, Atlanta, Tulsa, Dallas, Plainview and Lubbock, Texas; Fresno, Los Angeles; Phoenix, Albuquerque, New Mexico.

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Please send us a copy of the following bulletins:

☐ HYDRO-LINE PUMP ☐ TYPE PR PUMP

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COMPANY_____

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CITY_____ STATE_____

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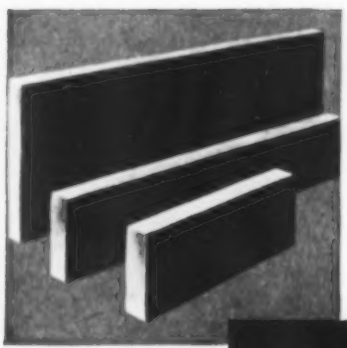
EAGLE-PICHER

Supertemp P-V Blocks



New light weight! Supertemp P-V Blocks are easily handled without breaking.

NEW STRENGTH AND LIGHT WEIGHT

for temperatures from

100 F. to 1900 F.

New strength of Supertemp P-V Blocks comes from a completely new manufacturing process developed by Eagle-Picher's research and engineering departments.

New light weight of Supertemp P-V Blocks results from the millions of "dead" air cells in Eagle-Picher's High Temperature Mineral Wool.

New strength plus extremely high thermal efficiency! Supertemp P-V Blocks are designed for continuous temperatures up to 1900 F. They're chemically and physically stable, too . . . ideal for heavy-duty insulating service.

New light weight makes P-V Blocks easy to handle—easy to apply—easy to cut for perfect fit. No special tools required.

And, of course, like all other Eagle-Picher insulation, Supertemp P-V Blocks soon pay for themselves in fuel savings and improved temperature control.

EAGLE-PICHER INSULSEAL PROTECTS! *Any insulation worth applying is worth protecting—and Insulseal provides a coating for insulation that dries to a flexible, hard, durable surface.*

Since 1843

EAGLE EP PICHER

THE EAGLE-PICHER COMPANY

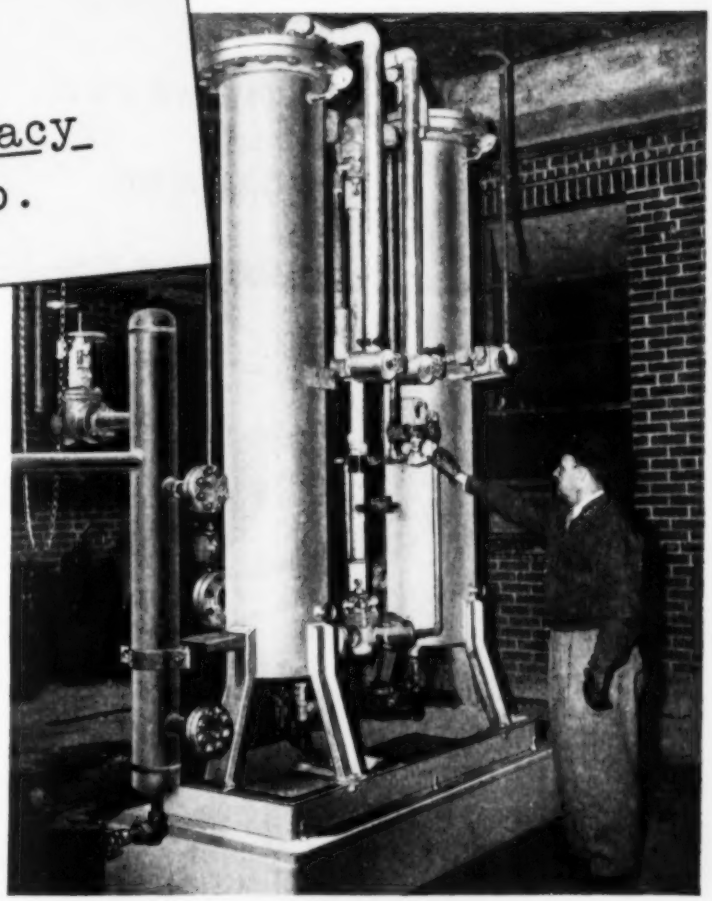
General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

Member of Industrial Mineral Fiber Institute

Case No. 64

Kemp Dryer
Assures Accuracy
For Sun Oil Co.



How SUNOCO® guarantees dependable instrument readings 24 hours a day

WHEN the Sunoco Plant at Marcus Hook, Pa., introduced a new process at the beginning of the year, many new instruments were installed. To dry the compressed air operating these instruments and assure accurate readings, Sunoco installed a Kemp Model 300 S Dryer.

Kemp Dryer Entirely Satisfactory

According to Harold Powers, Instrument Supervisor at Sunoco, the Kemp Dryer has been entirely satisfactory in performance. Operating continuously day and night since installation, it has performed according to specifications, has never been saturated, and has required very little attention.

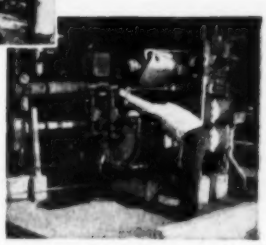
Kemp Dryers for Every Purpose

Kemp offers a variety of dryer models to meet all problems. Designed to dry air to sub-zero dew points at low cost, they are constructed of quality materials and embody the engineering knowledge gained from Kemp's many years of experience. They are available with manual, semi-automatic, or fully automatic tower reactivation. In addition, Kemp will prescribe the proper desiccant for each specific drying job. If you have a problem involving the removal of water from air, gases, or liquids, contact Kemp engineers now.

KEMP INERT GAS GENERATORS, too, serve Sunoco well

Sunoco reports that its two Kemp Inert Gas Generators have given highly satisfactory service. They are easy to start, and then operate automatically, requiring little attention. Both deliver high volume of gas of the proper analysis regardless of demand.

Kemp Inert Gas Generator Model C-5 MIHE. Delivers N_2 and CO_2 used to blanket top of wax tank.



Kemp Inert Gas Generator Model 8 MIHE. Produces N_2 and CO_2 for blanketing and for bubbler systems. Located in the open.

For more complete facts and technical information, write for Bulletin D-27 to:
THE C. M. KEMP MFG. CO., 405 East Oliver Street, Baltimore 2, Md.

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DYNAMIC DRYERS

CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • INERT GAS GENERATORS
SINGEING EQUIPMENT

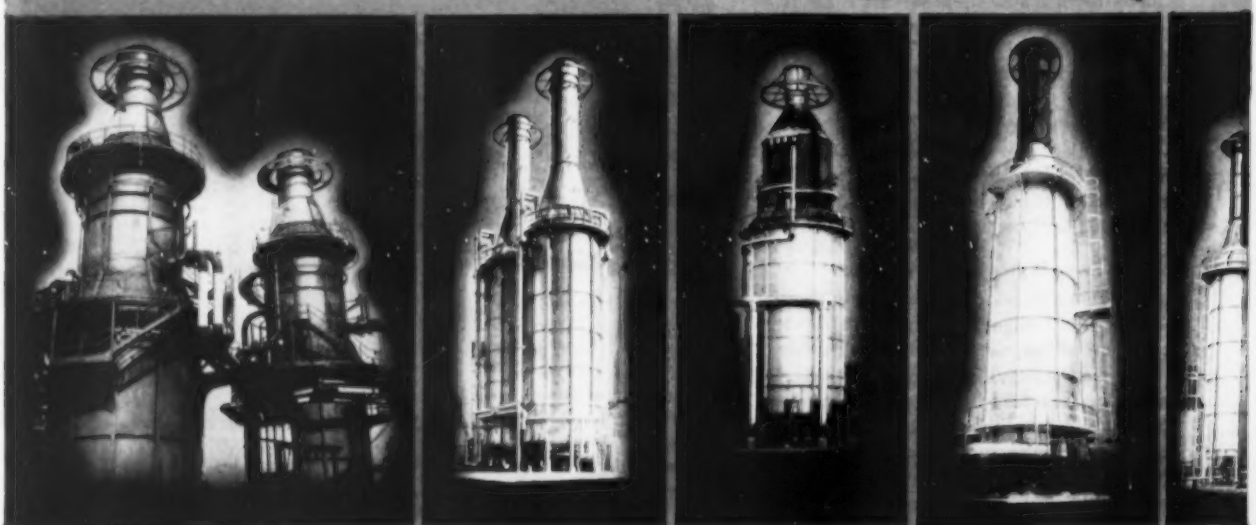
WHENEVER

YOU SEE

FURNACES

LIKE THESE

- MAXIMUM FUEL EFFICIENCY
- LOW PRESSURE DROP
- UNIFORM HEAT DISTRIBUTION
- LOW MAINTENANCE
- ZERO AIR LEAKAGE
- EXPLOSION RESISTANT
- MINIMUM GROUND SPACE
- SHORT LENGTH OF LIQUID TRAVEL
- EXCESS DRAFT FOR HIGH OVERLOAD
- SIMPLICITY OF DESIGN AND CONSTRUCTION
- PLENUM CHAMBERS FOR HAZARDOUS AREAS



PETROCHEM-ISOFLOW FURNACES

✳ UNIFORM HEAT DISTRIBUTION

Uniform heat distribution, the most desirable characteristic of any fluid heater, is created in an Isoflow furnace as the result of the following design characteristics:

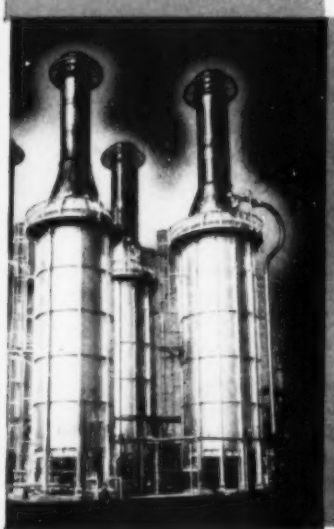
1. Individual burners, symmetrically spaced with relationship to the tubes, create a symmetrical flame pattern with relation to the heating elements.

2. The metal cone at the top of the combustion chamber re-radiates to the tubes, also diverts products of combustion progressively closer to the tubes, and combines the proper proportion of radiant and convection heat to give the uniform heat intensity at the upper portion of the combustion chamber.

3. The combustion gases are diverted behind the tubes so that the gases recirculate from the top of the heater downward, behind and between the tubes, thus increasing the heat input to the rear of the heating elements by convection.

4. The recirculated gases also serve to reduce the combustion temperature, reducing the heat intensity at the bottom of the furnace.

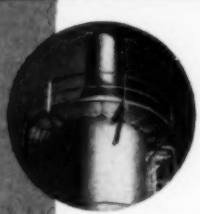
The above design factors in Isoflow heaters, combined with the angle of the cone, provide the uniform heat distribution required in heaters for the most efficient process operation.



you'll find

operating performance

MOST EFFICIENT BY ANY COMPARISON



PETROCHEM-ISOFLOW FURNACES

UNLIMITED IN SIZE ... CAPACITY ... DUTY

PETRO-CHEM DEVELOPMENT CO., INCORPORATED

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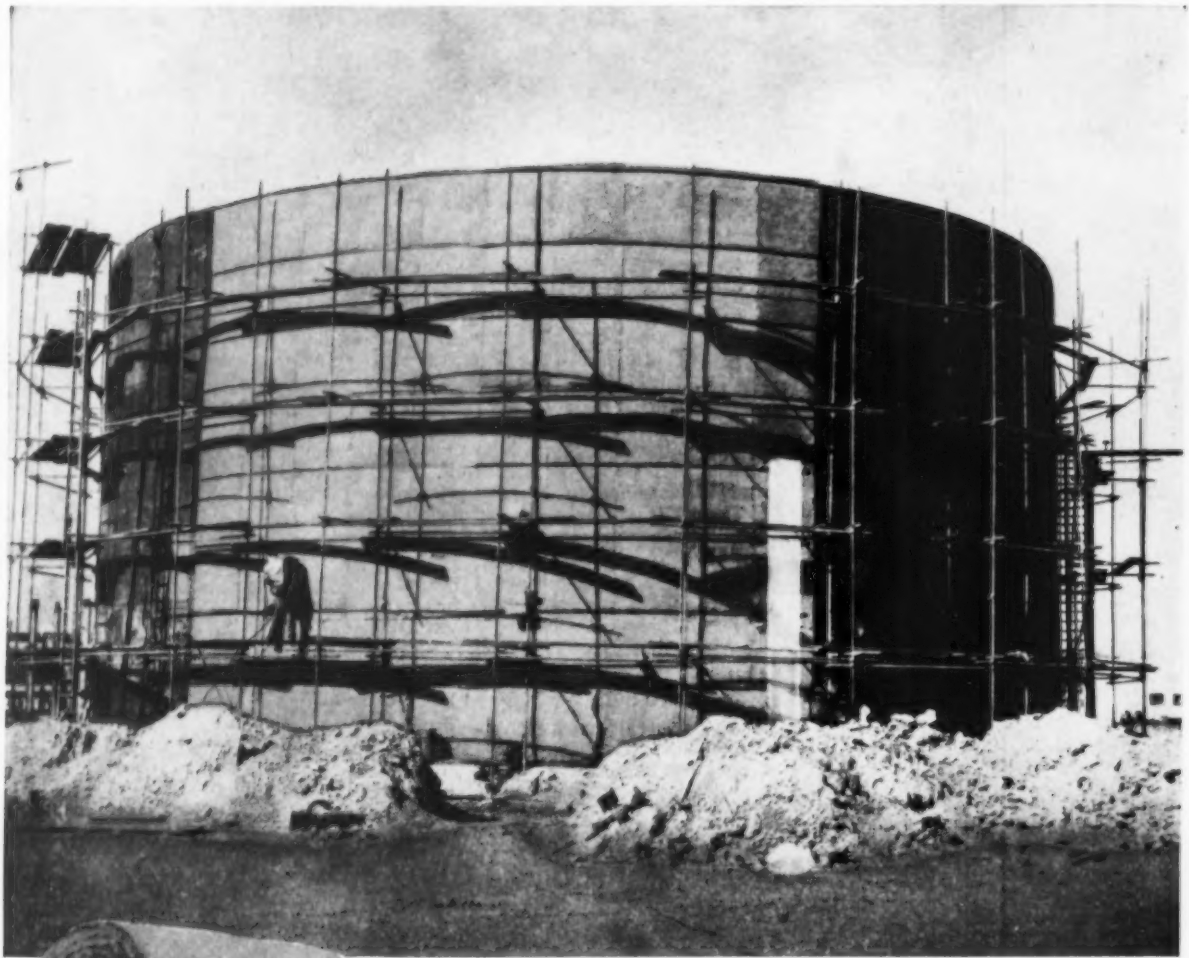
Representatives: Bethlehem Supply, Tulsa and Houston • Flagg, Brackett & Durgin, Boston • D. D. Foster, Pittsburgh • Faville-Levally, Chicago • Lester Oberholtz, California • Gordon D. Hardin, Louisville, Kentucky • Turbax Equipment Co., Narberth, Pa.



Contractor on the above illustrated job was the Joplin Cement Co., Joplin, Mo.

New Way to insulate storage tanks-

permanent, more efficient, more economical

If you could insulate *400 square feet* or more of a storage tank in one easy operation, how much could you save over the block-at-a-time method? You'd save plenty — as others are doing with ULTRALITE long glass fiber insulation.

The method is simple: Take a blanket roll of Ultralite and cut off strips the same length as the height of the tank. Start at the top of the tank and let a strip of lightweight Ultralite float toward the ground, impaling it on welded studs as it goes. No wiring, no banding. Just that quick, one part of the tank is insulated from top to bottom, and the insulation crew moves on, keeping well ahead of the men who apply the sheet metal jacket.

No expansion joints necessary . . . no damage from water . . . no heat loss from "fluing action" . . . no problems when tank repairs are necessary — for ULTRALITE is resilient, reusable, won't absorb moisture!

Write today for "how-to-do-it" specifications and name of your local Ultralite distributor

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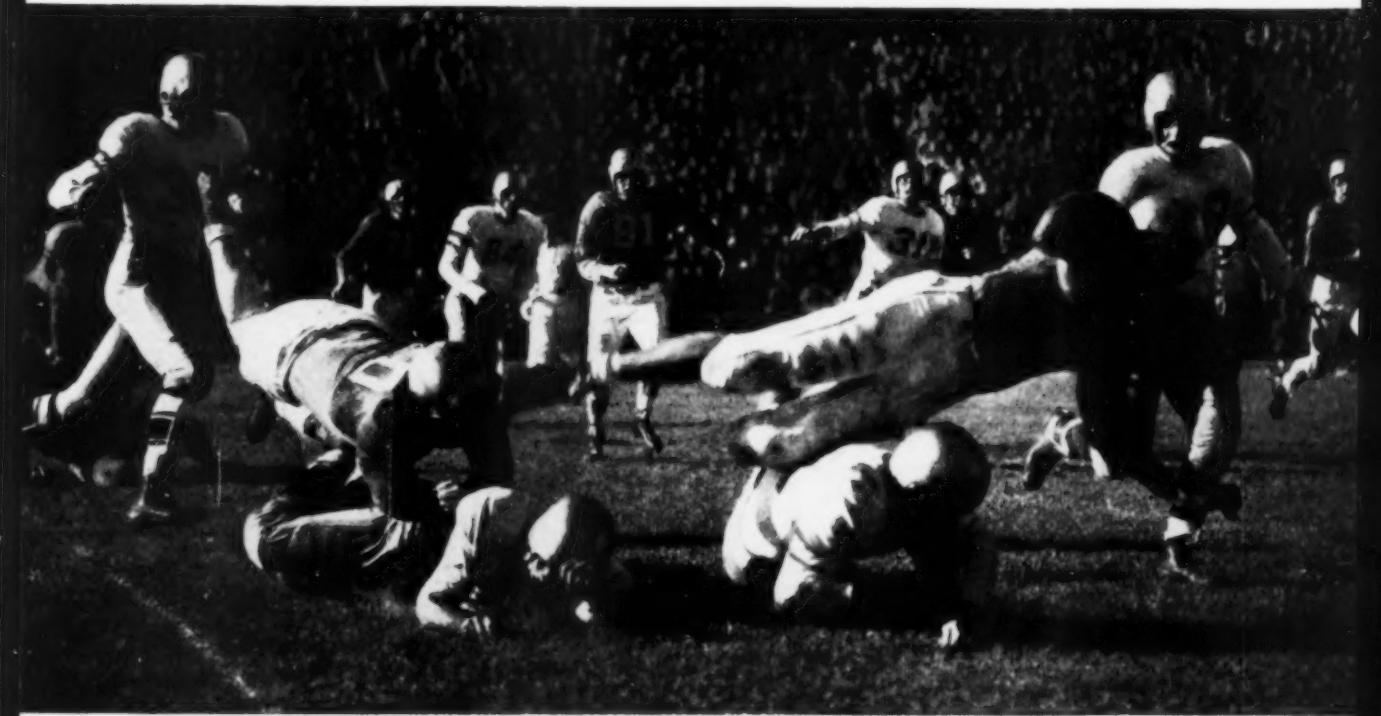
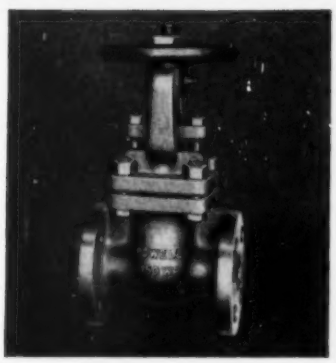
STAR PERFORMERS

From coast to coast, Powell Valves have won enthusiastic approval. For *every* Powell Valve is a *star for outstanding performance*. They have a record of dependability since 1846.

Small wonder that Powell Valves have made such a hit through the years. Powell has probably done more valve research, solved more valve problems and makes more types of valves than any other organization in the world.

We're sure that *you* will be enthusiastic about Powell Valves too once you see how they perform. Following are just a few members of the Powell all-star cast of valves which are available through distributors in principal cities. If a distributor is not located near you, just write us. We'll be pleased to tell you more about these valves—and our complete line.





O.S. & Y. GATE VALVE *(Fig. 2491)* for 150 pounds W.P. at 500 F. Stem is threaded and guided through a revolving bushing in upper yoke. Sizes ¼" to 2", inclusive.

CAST STEEL SWING CHECK VALVE *(Fig. 1561)* for 150 pounds W.S.P. Bolted flanged cap. Heavy rugged construction. Available in sizes ¾" to 18", inclusive.

BRONZE "WHITE STAR" GATE VALVE *(Fig. 375)* for 200 pounds W.S.P. Union bonnet with inside screw rising stem. Renewable "Powellium" Nickel-Bronze wedge.

CAST STEEL GATE VALVE *(Fig. 3003)* for 300 pounds W.S.P. Bolted flanged bonnet with outside screw, rising stem and yoke. Sizes 1" to 24", inclusive.

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Powell Valves

THE WM. POWELL COMPANY • CINCINNATI 22, OHIO

THIS INSUL-MASTIC COATING COST NOTHING...

It actually paid for itself in one year

The photograph shows INSUL-MASTIC TYPE "D" being applied on an oil tank that is kept heated to retain free flowing viscosity. Within one year after the completed application this coating of INSUL-MASTIC TYPE "D" prevented enough heat from escaping from the tank to pay for the cost of the coating. It also prevented corroding of the tank.

INSUL-MASTIC TYPE "D" is a *Superior* quality corrosion preventive coating to which we add considerable cork. We then apply it ¼ inch thick. It is not intended to replace standard thermal insulation, but on vessels where moderate temperatures are maintained it stops much heat loss while preventing corrosion.

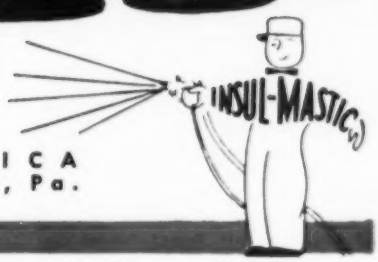
Applications as old as fifteen years have never required maintenance.

Write for further information.

To vaporseal thermal insulation specify INSUL-MASTIC 4010. Our technical engineers are available to help you with this and other coating specifications.

Think first of the coatings that last!

Insul-Mastic



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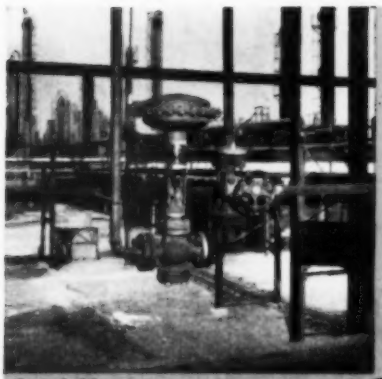
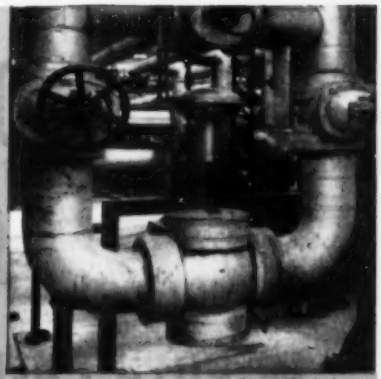


Control of Steam to Vacuum Jet

FOR CRITICAL PROCESS CONTROL

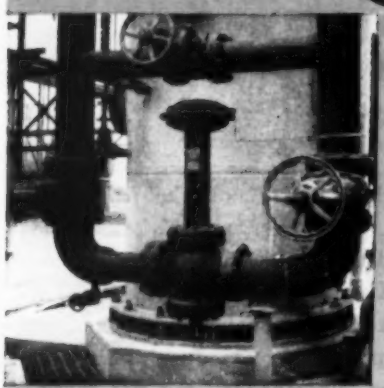


Steam Control to Flash Tower

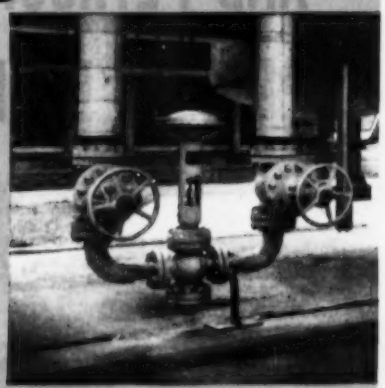
Celanese

REG. U.S. PAT. OFF.

USES



Steam Control to Reboiler

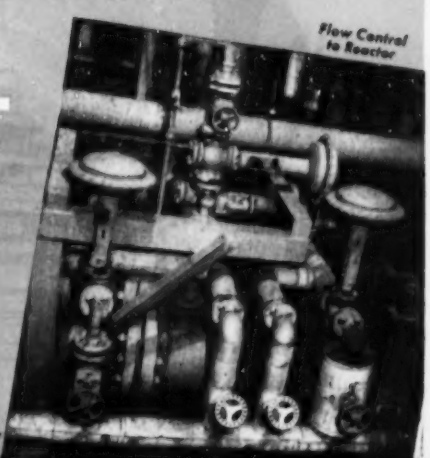


Control of Water to Waste Heat Boiler

HAMMEL-DAHL

CONTROL VALVES

Control of Feed to Flaker



Flow Control to Reactor

OUR CATALOG "B" WILL HELP SOLVE PROCESS CONTROL PROBLEMS

Write For Your Copy Today

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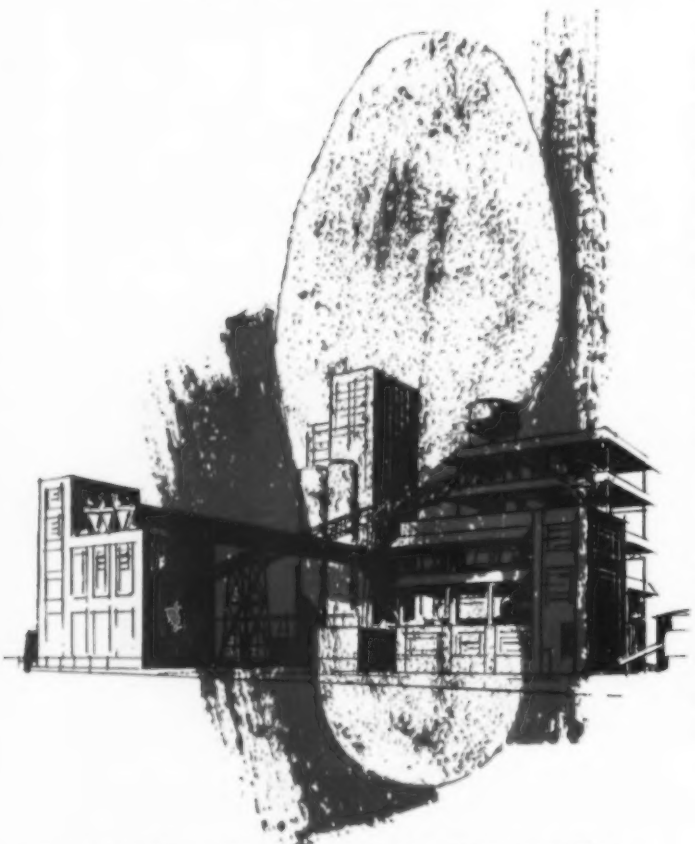
BLAW-KNOX HAS MADE *GREAT STRIDES* IN BOTH CHEMICAL AND PETROCHEMICAL PROJECT DEVELOPMENT



Time was when Blaw-Knox Company was noted chiefly for its outstanding work in the Chemical and Processing fields. Today, however, Blaw-Knox Chemical Plants Division can look back on the pioneering role it played in the young petrochemical industry! Much of this work was "unorthodox" but not speculative. In every instance, the client came to us with a problem he wanted solved. We engineered an economical solution, and built a successful plant. We welcome the opportunity to put this experience behind any project you may be contemplating.

PLANTS & PROCESSES

Catalytic Reforming • Catalytic Cracking • Decarbonizing • Waste Disposal • Crude Distillation • Ethylene Oxide • Fischer-Tropsch Oxo • Caustic Soda & Chlorine • Extraction • Fractionation • Package Gasoline Stripping • Recycling • Alkylation • Resin Polymerization • Tonnage Oxygen • Synthetic Fuels

Visit the Blaw-Knox booth at the Chemical Show, November 30 through December 5, 1953. Booth 103.

BLAW-KNOX COMPANY
CHEMICAL PLANTS DIVISION
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BLAW-KNOX

How many bolts are required for a perfect seal?

Should it be 10, 14, 18? Where do you stop?
In the patented K & M "Duoseal" design, just two bolts are required.
And you obtain a tight seal . . . not at 10, 14 or 18 points on
the casing . . . but *a continuous seal at infinite points throughout the entire perimeter.* The result: A completely tight, leakproof
seal that actually grows tighter as control pressure increases.
Furthermore, K & M "Duoseal" saves maintenance time with only two bolts
to tighten. This time saving is a particular consideration
when valves *must* be serviced or inspected in the line.
Within the drawn steel diaphragm casing, the K & M molded neoprene
diaphragm provides an extremely large effective area
that is constant throughout the long stem travel. Virtually the highest
"power factor" available results, with more sensitive response
to control pressure variations, more accurate inner valve positioning and
improved flow regulation through the K & M valve body.

For Complete Automatic Control Valve Data: **Write for your copy of the new K & M Valve Engineering Data Catalog, Bulletin CV53.** ***Also, Available... New*** **Valve Size Calculator with Low Flow Data.**

diaphragm control valves

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prelude to a partnership

When a petroleum refiner decides to do business with Universal, he immediately becomes something more than just a customer. He actually enters a partnership with an organization whose interests are parallel to his own.

Universal's objectives are basically the same as the petroleum refiners' . . . to provide continuing improvement of products from petroleum through constant advancement in

refining methods and techniques. Universal endeavors to accomplish these objectives in a manner that will result in the greatest economic advantage to the petroleum refiner.

As originators and developers of many of the most successful refining processes, Universal has only a single purpose to pursue—the progress of its customers—progress based upon the intelligent understanding of processing requirements and sound interpretations that provide effective solutions to the industry's most complex problems.

The petroleum refiner's interests are our interests—his success, our success. We like to think about him as our partner—not just a customer. Unusual as it sounds—Prelude To A Partnership—does have a significant meaning in our business.

UNIVERSAL OIL PRODUCTS COMPANY

UOP

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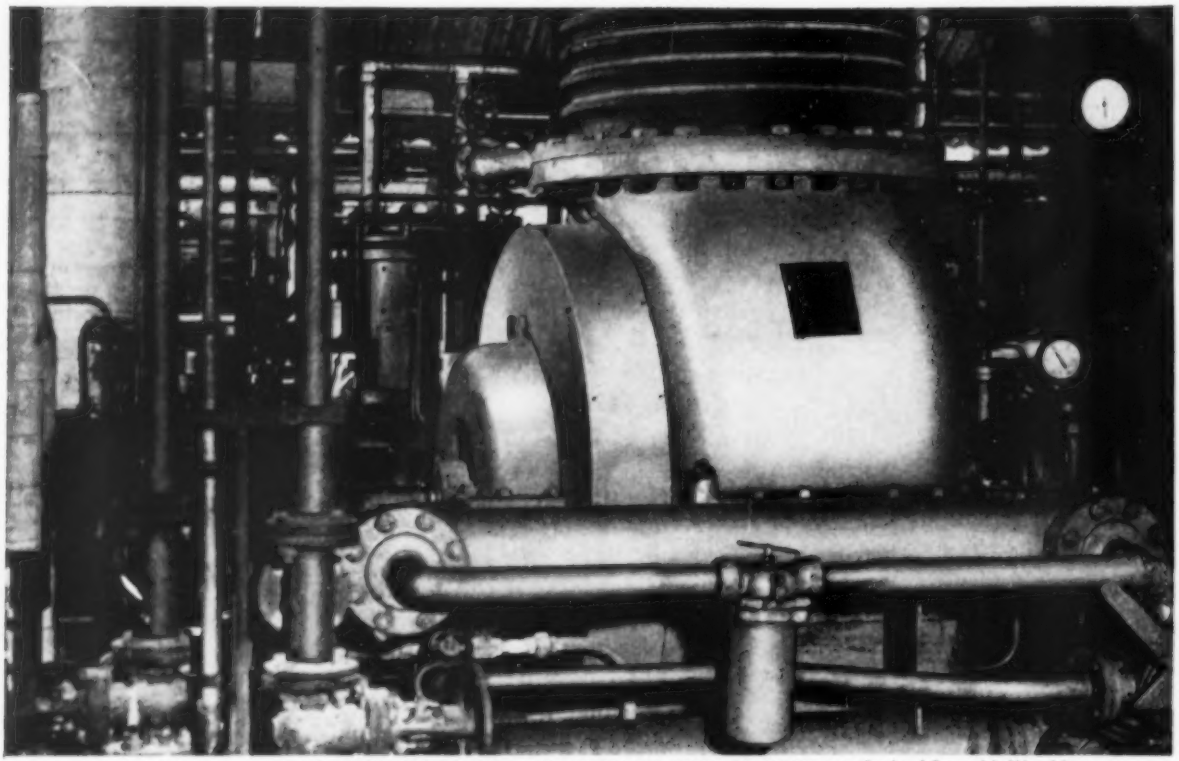
Laboratories: RIVERSIDE, ILLINOIS

Universal Service Protects Your Investment



LOW MAINTENANCE COSTS AND EXCELLENT STEAM ECONOMY are obtained from this Worthington high-speed turbine, one of two used to drive centrifugal blowers in this up-to-date refinery installation.

8000 rpm steam turbines operate on only 15 pounds inlet pressure

Worthington high-speed units at a Gulf Coast refinery drive centrifugal blower in cat cracker

• Steam at a pressure of 15 pounds is all it takes to power the two high-speed Worthington turbines that drive centrifugal compressors for the refining process in a cat cracker at a large Gulf Coast refinery.

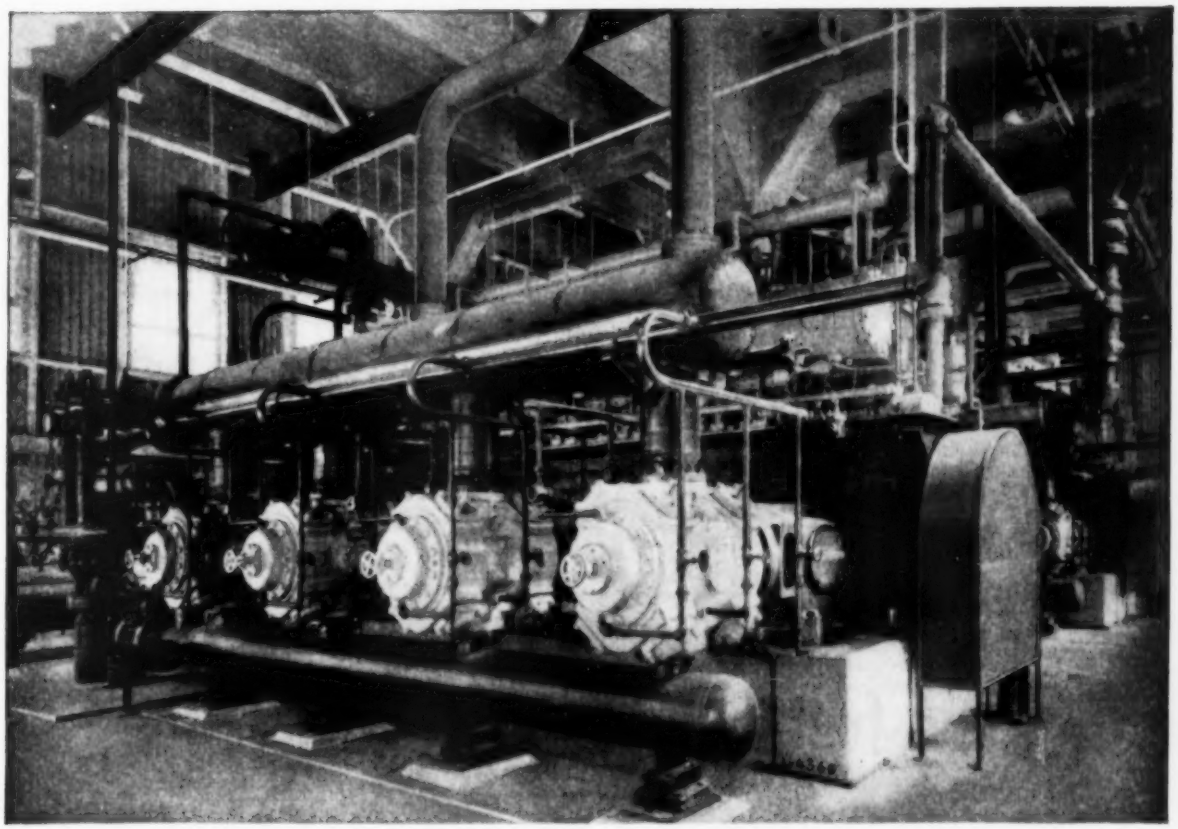
Worthington steam turbines are ideally suited for blower or centrifugal compressor drives, since they are built in all sizes and speeds for the most economical unit performance. There's no need for costly speed increasing gears, either, and the turbine's adaptability to various governing arrangements allows precise control under all operating conditions.

Remember, the engineering of the drive is just as important as the engineering of the compressor or blower. Worthington's long experience in compressor-drive engineering is your assurance of getting exactly the right type and size drive for your needs. Write today for Bulletin 1966 to Worthington Corporation, Steam Turbine Division, Wellsville, New York. T.3.5

WORTHINGTON

A GREAT TEAM IN STEAM

Single-Stage Turbines • **Multi-Stage Turbines** • **Turbine-Generator Sets** • **Feed Water Heaters** • **Boiler Feed Pumps** • **Surface Condensers**



WORTHINGTON ANGLE GAS-ENGINE COMPRESSOR installation in a gas pipeline pumping station.

Now . . . more horsepower, higher efficiency in Worthington Angle Gas-Engine Compressors

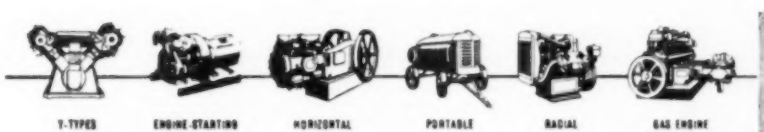
New LTC-H compressor has all advantages of famous LTC plus high compression

This new Worthington LTC-H Angle Gas-Engine Compressor—the latest Worthington advance in its engine-compressor design—is typical of the kind of improvement achieved by Worthington engineers throughout many years of leadership in the manufacture and application of compressors and large internal combustion engines.

The new high-compression engine-compressor has considerably higher horsepower ratings than its well-known predecessor, the LTC, but runs cooler and on less fuel. LTC-H users will find the new unit is built to give the same day-in, day-out service that has given all Worthington Engine-Compressors a reputation for extreme dependability throughout the gas, petroleum and chemical worlds in *pipeline pumping, refinery operations, public utility gas distribution,* and service in *natural gasoline and pressure maintenance plants, petro-chemical and synthesis plants,* and *refrigeration plants.*

Write for more information on this latest development in Bulletin L-690-B1B or let us know that you're interested in conversion of your present unit. Worthington Corporation, Compressor Division, Buffalo, N. Y.

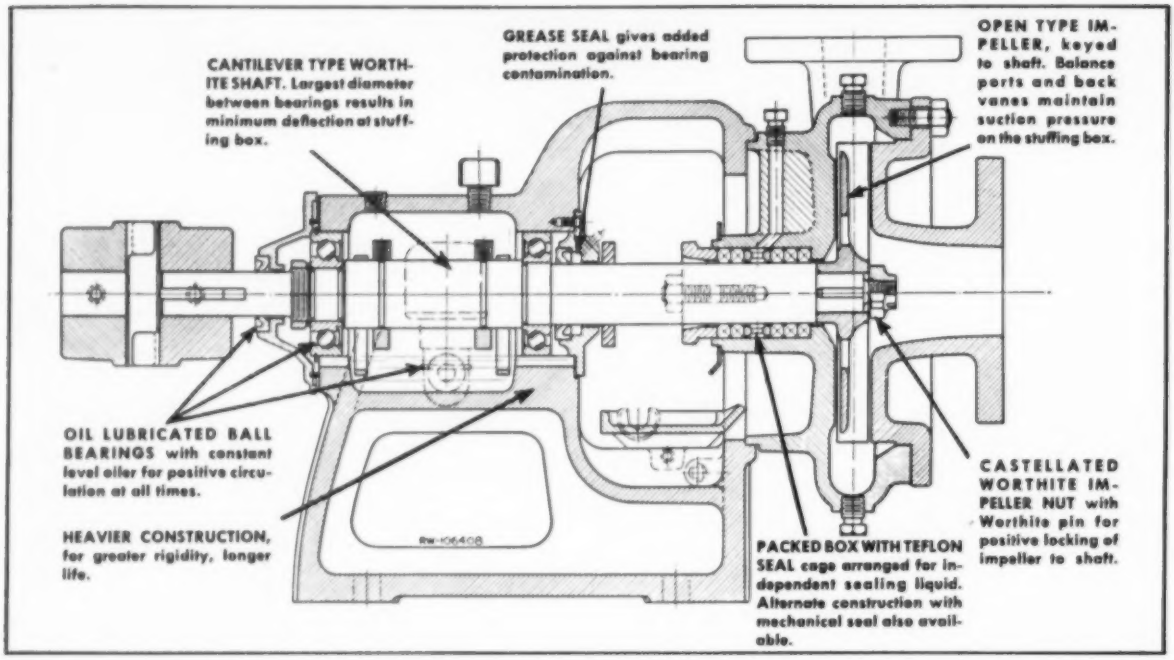
K-2.16



NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON

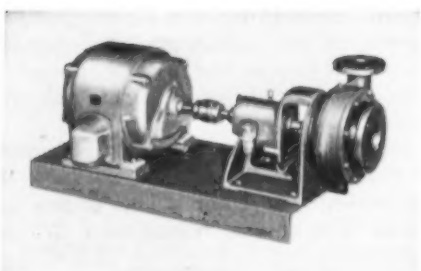
WORTHINGTON

Engine Compressors


CANTILEVER TYPE WORTHITE SHAFT. Largest diameter between bearings results in minimum deflection at stuffing box.
GREASE SEAL gives added protection against bearing contamination.
OPEN TYPE IMPELLER, keyed to shaft. Balance ports and back vanes maintain suction pressure on the stuffing box.
OIL LUBRICATED BALL BEARINGS with constant level oiler for positive circulation at all times.
HEAVIER CONSTRUCTION, for greater rigidity, longer life.
RW-106408
PACKED BOX WITH TEFLON SEAL cage arranged for independent sealing liquid. Alternate construction with mechanical seal also available.
CASTELLATED WORTHITE IMPELLER NUT with Worthite pin for positive locking of impeller to shaft.

New features make Worthington's corrosion-resistant pumps better than ever

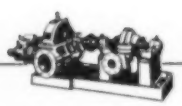
Worthington also increases size and capacity range of Worthite pumps, standardized with packed box or with Worthington mechanical seal



THE NEW CNG WORTHITE PUMP comes in 21 sizes, ¾" to 6", up to 2000 gpm. Heads up to 200 feet. Write for our new Bulletin W-350-B14 to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey. C.3.7

CENTRIFUGAL STOCK PUMPS
Type FP. Handle all kinds of stock up to 6½% consistency. 6 sizes. Capacities up to 6000 gpm; heads up to 160 ft.

GENERAL PURPOSE PUMPS
Type CN. Single stage. Sizes ¾ in. to 6 in. Capacities up to 2400 gpm; heads to 390 ft.



BOILER FEED PUMPS
Capacities up to 2000 gpm; pressures to 1250 psi.

WORTHINGTON

Centrifugal Pumps

REFINERY PROCESS NEWS

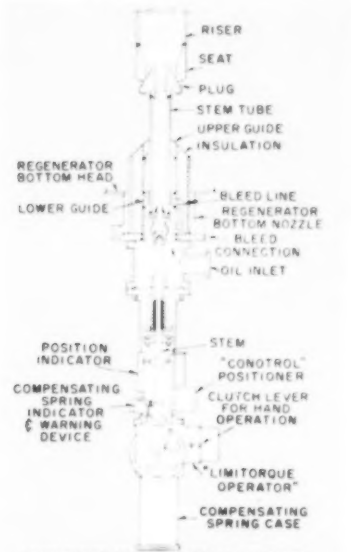
PUBLISHED BY REFINERY PROCESS DIVISION, THE M. W. KELLOGG COMPANY — NOVEMBER 1953

Patented Plug Valve Key to Orthoflow's Operating Ease

Unique mechanical features of the Orthoflow Fluid catalytic cracker are the plug valves which replace the more conventional slide valves. Designed and patented by Kellogg, they might well be termed the key to the decreased investment, easy operation and low maintenance cost of the Orthoflow.

Not only do they make feasible the elimination of expansion joints in certain of the Orthoflow units, but also they are much more easily maintained than slide valves. Actually, the new valves make possible the basic advantage of the Orthoflow: Straight-line flow of catalyst with its concomitant reduction in erosion.

The plug valves are so arranged that they can be unflanged, lowered from the bottom head and taken to a shop for maintenance while the rest of the unit is being inspected and repaired.



PLUG VALVE FOR REGENERATED CATALYST

Although the plug of the valve is subjected to the same type of erosion that is encountered in slide valves, and its rebuilding or replacement must be expected after about a year of service, the valve seat and the straight catalyst lines themselves have proven remarkably free of erosion difficulties. Only minor repairs have so far been necessary.

All these factors, coupled with the ease of shut down and start up, make the Orthoflow design a highly attractive one.

Combination Processing Can Reduce Total Investment Costs by More Than 20%

Recently completed economic studies by Kellogg comparing combination refining with conventional sequence-type unit-processing show the remarkable savings in investment and operating costs as well as the improved yields that may be obtained through the integration of a petroleum refinery.

Today it is possible by skillful integration not only to cut the cost of the processing equipment from five to 15% but also to reduce the cost of offsite facilities by as much as 25%. The overall effect results in the possibility of erecting complete new combination refineries at perhaps 20% less than the cost of building comparable capacity in individual process units.

Important savings also result from reduced operating costs such as labor, fuel, power, steam, water, and maintenance.

Although there are savings in utilities—particularly through the conservation of heat due to the virtual elimination of intermediate storage—and in maintenance charges, the largest single reduction in direct operating costs for combination units results from smaller labor requirements. Total operating personnel needs may be slashed by as much as 30%.

In addition to the savings already mentioned, the combination plant has a further advantage in improved yields due to a reduction in evaporation and other losses. An increase in gasoline yield of about one percent may be expected in a combination unit—an important source of increased earnings and quicker payout. (Shown above is a typical modern combination catalytic refinery.)

NOTE: For more extensive study of combination refining and its advantages send for KELLOGGRAM No. 1, 1953 which compares the economics of 10, 20 and 40,000 BPD combination units with conventional plants of equal capacities.

SEE REVERSE SIDE

CONTINUED FROM PRECEDING PAGE

Operating Data Reveals Kellogg Reactor Efficiency

Recent operating data from two relatively new sulfuric acid alkylation plants clearly reveal that the Kellogg cascade reactor is highly effective in producing excellent yields of high-octane alkylate with a minimum consumption of acid.

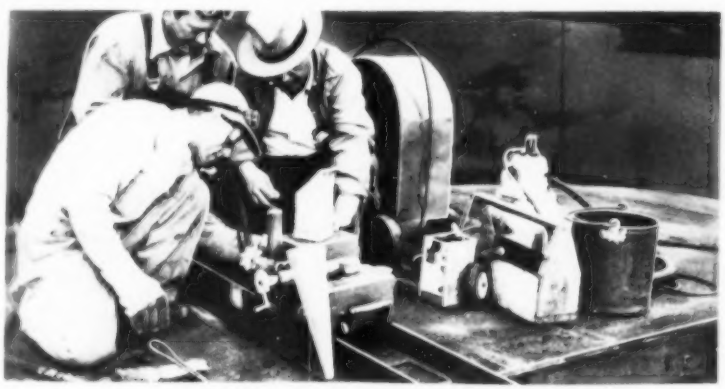
While the data from both units indicate efficient performance, it is interesting to note the difference in the yield, octane rating and consumption of acid in the instance where the feed contains a high percentage of propylene.

As shown in the accompanying tables, propylene is a satisfactory feed, but it does not produce as high octane numbers or consume as little acid as butylene alkylation.

			Butylene Mo. %	Propylene Mo. %
Olefin feed composition		C_3H_8	6.4	23.5
		C_4H_8	19.5	15.2
		iC_4H_{10}	33.8	29.9
		nC_4H_{10}	17.4	4.2
		C_5H_{10}-1† C_5H_{10}-2†	20.5	23.8
		C_5H_{12}†	2.4	3.4
		C_5H_{12}†		
		Total	100.0	100.0
Acid consumption lbs. gal. total alkylate			0.7	1.05
Light alkylate inspections	°API		70.8	72.8
	ASTM Dist. °F	IBP	120	110
		10	180	150
		20	200	170
		50	220	200
		90	240	240
		EP	340	320
		% REC	98.0	99.0
	RVP		5.6	5.8
	Octane	F-1 Clear	96.2	93.4
Light alkylate yield (Basis total alkylate)			95 LV. %	93 LV. %

Kwinana Refinery Takes Shape

Work is proceeding steadily on the new Anglo-Iranian refinery at Kwinana, Australia. (Above) Progress on the Orthoflow Fluid catalytic cracking unit . . . the guy derrick is just being installed for lifting the various towers and vessels onto the foundations which may be seen in the center of the site. The unit will be a Model "B" Orthoflow in which the regenerator is located on top of the reactor to reduce compressor horsepower requirements. (Below) A typical example of the use of standard shop equipment in field fabrication. Shown is a portable continuous welding machine, being used here for the fabrication of tank shell plate.



For further information, technical data, etc., on any refining process, write

Autofining Economics are Attractive . . .

Although Autofining, AIOC's new desulfurization process licensed by Kellogg, shows excellent economics in comparison with acid treating as a method of removing sulfur from kerosene, it shows an even more attractive payout time when it is used to treat gas oil.

The economic summary below takes into account direct operating costs and treating losses, but excludes taxes, depreciation, interest and royalty for both treating methods. Direct operating costs include labor, maintenance, utilities, chemicals and catalyst. Acid required for treatment of kerosene and gas oil is 15 and 40 lbs./bbl. respectively. The payout periods on incremental investment for the Autofining cases are very short, and the Autofining process appears to be both an economical and flexible method of reducing the sulfur content of straight-run petroleum distillates.

	KEROSENE		GAS OIL	
	(Sulfur reduced from 0.4 to 0.05 wt. %)		*(Sulfur reduced from 1.2 to 0.6 wt. %)*	
Investment, 3,500 BPSD Plant	$650,000	$320,000	$800,000	$320,00
Direct Operating Costs, $ Bbl	0.095	0.218	0.104	0.485
Treating Loss, Vol. %	0.5	4.5	1.5	10.0
Incremental Savings for Autofining, $ Year	305,000	—	748,000	—
Payout on Incremental Investment, Years	1.08	—	0.64	—

REFINERY PROCESS DIVISION

THE M. W. KELLOGG COMPANY

225 Broadway, New York 7, N. Y.

Also Jersey City, Chicago, Los Angeles, Tulsa, Houston, Toronto, London and Paris

A SUBSIDIARY OF PULLMAN

Background photo courtesy of Shell Oil Company

J-M CHEMPAC®—an asbestos-Teflon packing that withstands virtually ALL chemicals

THIS NEW Johns-Manville development combines the sealing action and heat-resistant characteristics of asbestos with the all-around chemical resistance of Teflon. Its base is strong, resilient asbestos fibers thoroughly impregnated with chemically inert Teflon.

The versatility of Chempac greatly reduces the number of packing styles needed for chemical equipment. Stocking presents no problem because its inert ingredients do not deteriorate.

Chempac can be recommended for packing pump rods or shafts, valve stems, agitator shafts, expansion joints, rotary filters and similar apparatus. It is outstanding in service against many acids, alkalies, caustic solutions, and solvents, at temperatures to 525° F.

Chempac Packing is available in coil, spiral and ring form for rod, plunger and valve stem service. Style Nos. 2011, 2012 and 2013 are made of white Canadian Chrysotile Asbestos. No. 2014 is made of blue African Crocidolite Asbestos. Johns-Manville also makes Chempac Gaskets, Nos. 117 and 138 of plies of asbestos cloth treated with Teflon.

Your Johns-Manville Packing Distributor can help you select the right Chempac Packing or Gasket for your application. For complete information write him or Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

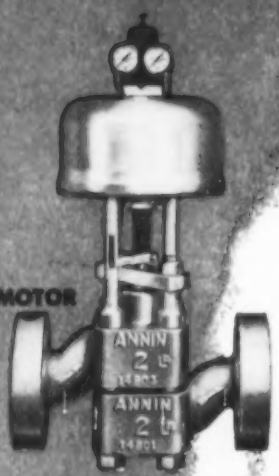
REACHING FOR NEW HIGHS

Annin's Guided Missile Achievements Help Solve YOUR Extreme Pressure Control Problems

Annin's superiority comes from the rugged proving grounds of guided missile work, where simple valve design, rugged construction and dependable operation are the factors that count. From this beginning Annin research and engineering have constantly reached for "new highs" in efficient control of difficult fluids under extreme conditions of pressure and temperature. This experience can now be applied in solving YOUR high pressure problems with these new standard model Annin Domotor, Cylinder and Handwheel operated valves. Pressure and temperature ratings of 6000 psi (standard*) and —325° F to 1200° F. Like all Annin models they offer flexibility in operation, bubble-tight shut-off, reduction in valve inventory and low maintenance cost. Get the facts today on ANNIN's work in the high pressure field, and what this experience can mean to you in savings and service.

*Special valves now in production to 30,000 psi

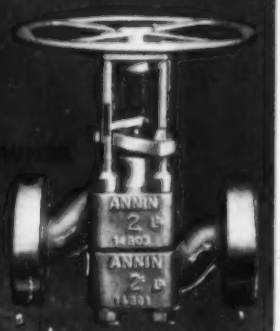
DOMOTOR



Model 2560, series 90-150, pressures to 3600 psi; temperatures —325° F to 1200° F.
Model 3560, series 250, to 6000 psi.

CYLINDER

Model 2520, series 90-150, pressures to 3600 psi; temperatures —325° F to 1200° F.
Model 3560, series 250 to 6000 psi.



Model 25, series 90-150, pressures to 3600 psi; temperatures from —325° F to 1200° F.
Model 35, series 250, to 6000 psi.

WRITE TODAY
for illustrated Bulletin showing how and why Annin offers the best buy in control valves.

THE ANNIN COMPANY
3500 UNION AVENUE, LOS ANGELES 23, CALIFORNIA

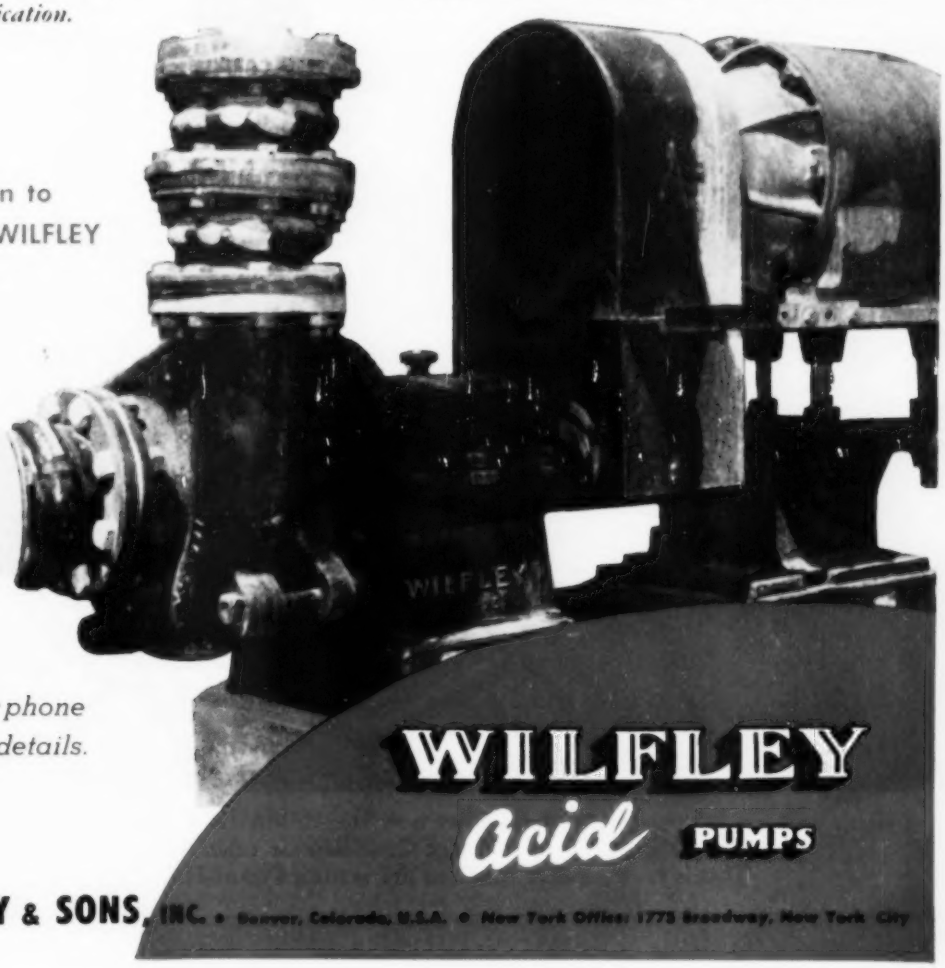
ANNIN *Control* **VALVES**

Cost-Saving Efficiency in handling Hot Liquids, Acids, Corrosives

This highly efficient and economical application is typical of WILFLEY chemical-plant installations throughout the world. In every instance, WILFLEY acid pumps handle acids, corrosives, hot liquids and mild abrasives at costs which materially increase operating profits. Continuous, trouble-free performance 24 hours a day without attention. 10- to 2,000- G.P.M. capacity; 15- to 150-ft. heads and higher. An economical size for every requirement.

- *Wetted parts of all machinable alloys. Plastic linings available.*
- *Individual engineering on every application.*

A companion to the famous WILFLEY Sand Pump.



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WILFLEY *Acid* **PUMPS**

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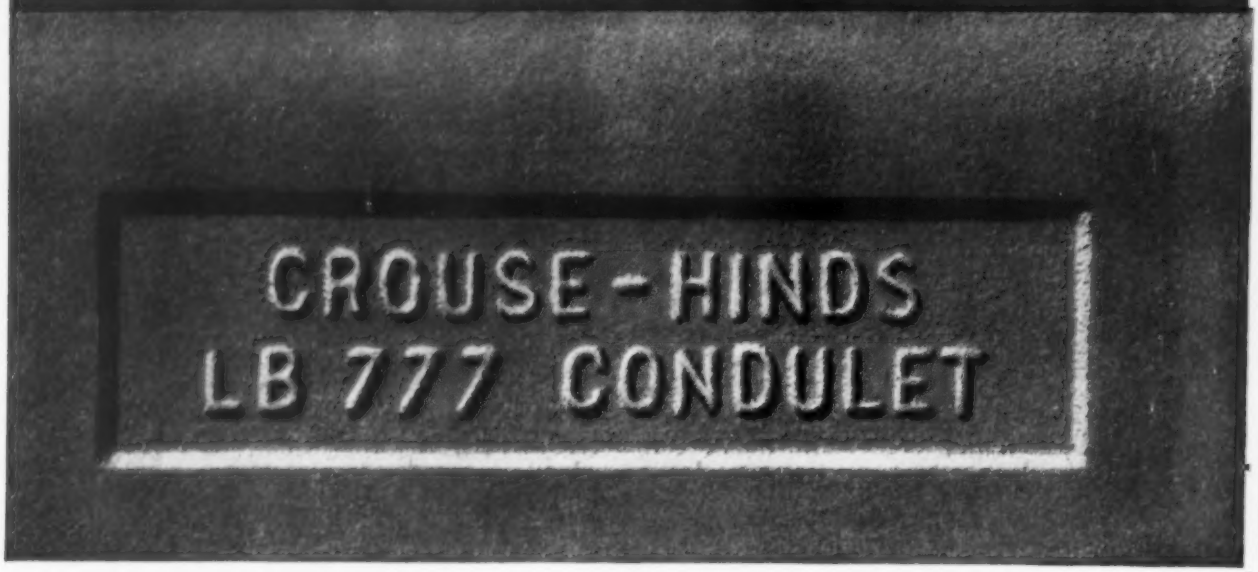
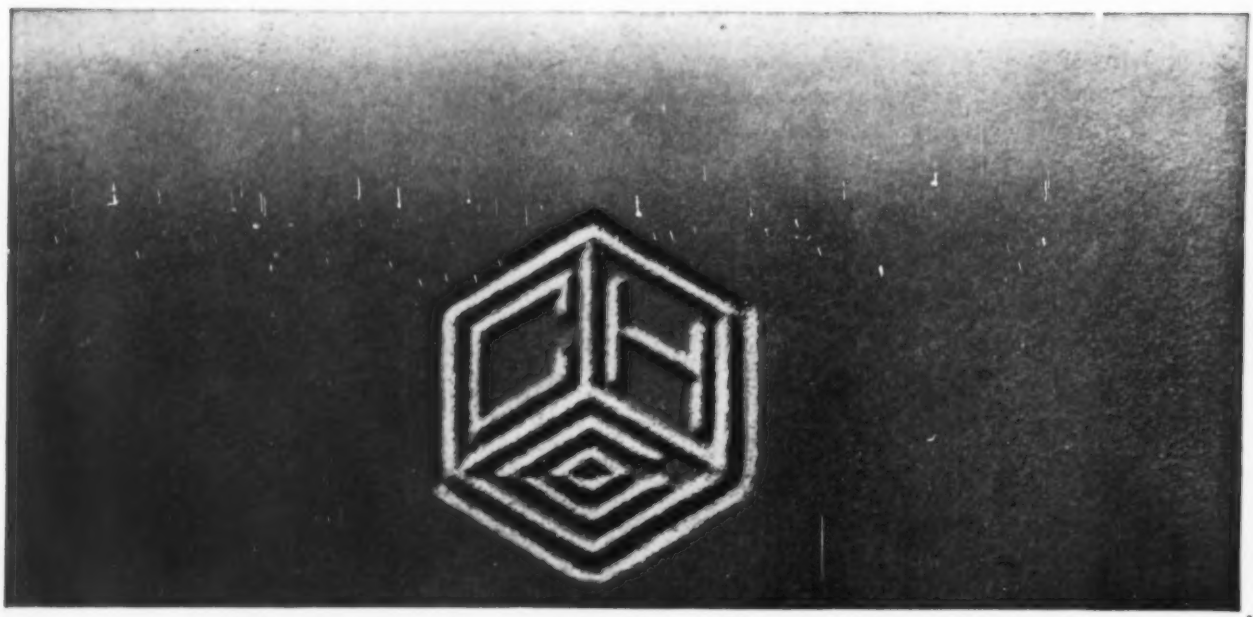
When you ask for



Enlarged view showing how Crouse-Hinds trademark CONDULET is cast right into the body of Condulets for your protection. No other manufacturer can use this trademark.



Enlarged view that shows how the Crouse-Hinds Company cube trademark is cast into the body of Condulets or other Crouse-Hinds products. This is an assurance that you are getting Crouse-Hinds quality.

CONDULETS · TRAFFIC SIGNALS

CONDULETS... be sure that you get CONDULETS*

There is no substitute for CONDULET quality

CONDULETS have always been of the highest quality. To maintain its position of leadership Crouse-Hinds has a large Engineering Dept. constantly developing new products to add to the CONDULET line and improving old ones. Crouse-Hinds foundry and factory have the latest mechanical improvements and modern machinery. This enables the highly skilled craftsmen to turn out a product that is tops in quality. Constant checking and testing proves that this is true.

When CONDULETS were introduced by Crouse-Hinds in 1905 they completely revolutionized electrical conduit installation practice. This newly invented line of conduit outlet bodies was so superior to anything else on the market that all electricians were soon using them. They were of such high quality that many of those early installations are still in use . . . in tip-top condition.

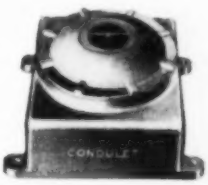
When imitations appeared on the market, it isn't a bit surprising that many people called all conduit fittings Condulets. Of course, we appreciate this compliment, but it often leads to confusion. It can be very disappointing if you think you are getting CONDULETS and later discover that the installation was made with a product of some other manufacture.

CONDULET is not a common noun. It is a coined word registered in the U. S. Patent Office and designates a product made only by Crouse-Hinds Company.

You can be sure of getting CONDULETS by buying from one of Crouse-Hinds authorized electrical distributors. They are ready to serve you throughout the country. Ask for CONDULETS. Then look for the word CONDULET or the C-H Co. cube trademark on the body. These trademarks appear on every genuine CONDULET.

Type LB
Obround Condulet

Type GUAC Explosion-Proof
Junction Condulet



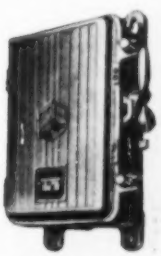
Type GUB Explosion-Proof
Junction Condulet

Type FSC Tumbler
Switch Condulet

Type EFS Explosion-Proof
Pilot Light Condulet

Type EVA Explosion-Proof
Lighting Fixture

Type AREA
Plug Receptacle



Type WMK Watertight
Safety Switch Condulet

When you ask for Condulets
be sure that you get CONDULETS

*CONDULETS are made only by CROUSE-HINDS

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

OFFICES: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston
Indianapolis — Kansas City — Los Angeles — Milwaukee — New Orleans — New York — Philadelphia — Pittsburgh
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CONDULET
First in the field
STANDARD OF QUALITY

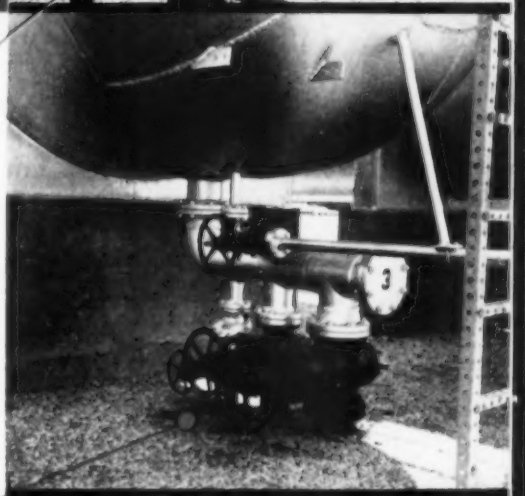
A Nationwide Distribution Through Electrical Distributors

C-H

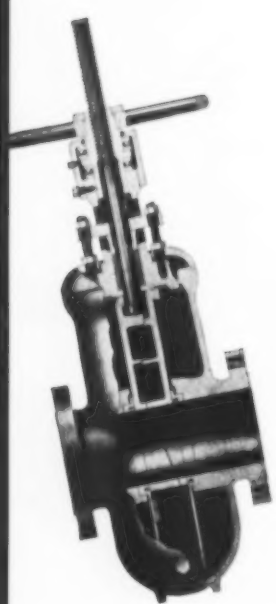
FLOODLIGHTS · AIRPORT LIGHTING

W-K-M PROCESS VALVES FOR GASOLINE PLANT SERVICE

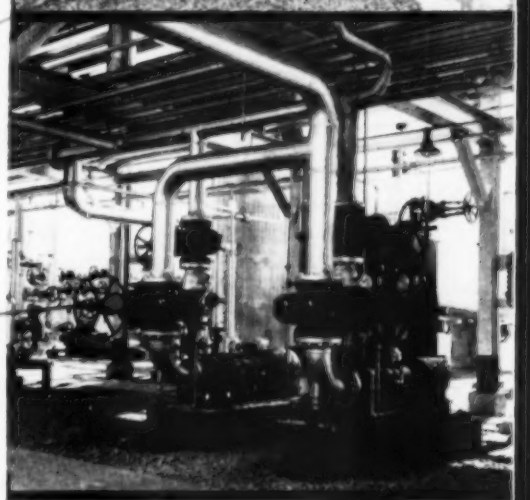
When you figure that W-K-M Process Valves have metal-to-metal seals to provide complete safety under any conditions, that they permit full pipe-diameter flow without turbulence, that positive opening and closing are guaranteed by W-K-M's exclusive Leverlock design, that they can be completely overhauled with very little trouble while on the line, that they are available in any trim for any process service—high pressure hot or low pressure cold—it is no wonder that more and more gasoline plants and refineries are specifying W-K-M for the key jobs—and some plants use them all the way through. Write for Bulletin 698 for the complete data about these valves or ask for a W-K-M sales engineer to call.



These valves and those shown below are in a gasoline plant in West Texas. Reading from left to right in above photo, the valves are in service on loading pumps handling butane, at 125 psi ga., 85° F; gasoline, 75 psi ga., 85° F; propane, 225 psi ga., 85° F.

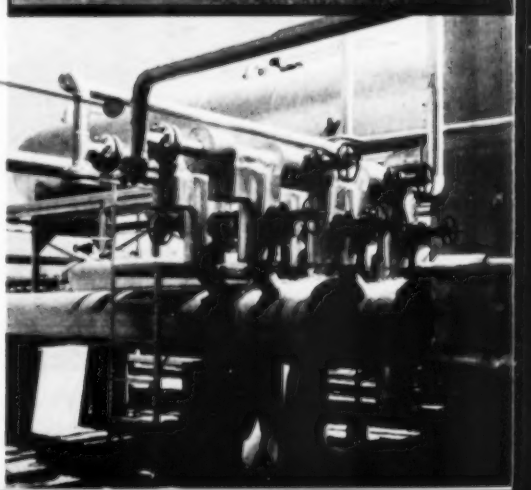


At left is cutaway section of the W-K-M Process Valve. Shown below is drawing of the exclusive W-K-M Leverlock mechanism which guarantees positive opening and closing under all conditions.



W-K-M Valves on butane stock tank at 125 psi, 80° F. Four valves are used on each tank and there are ten tanks.

These valves provide reflux to propane fractionator. They handle propane at 275 psi ga., 108° F.



These jacketed valves handle unstabilized gasoline at 550 psi ga., 260° F. in deethanizer feed exchanger.

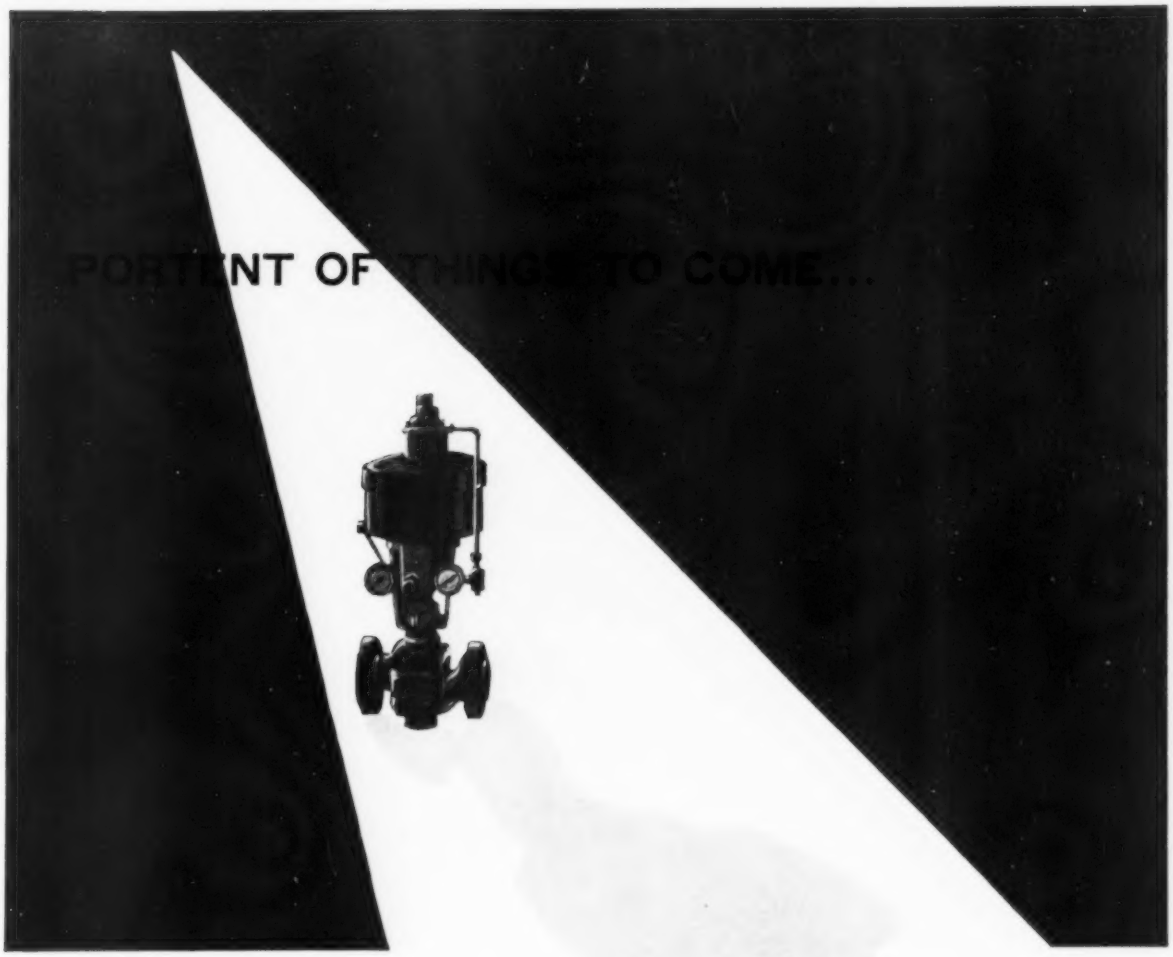
W-K-M Valves

W-K-M COMPANY

P. O. BOX 2117 HOUSTON 1, TEXAS

2330 E. 8th St., Los Angeles, Calif.

Export Office: 30 Rockefeller Plaza, New York, N. Y.



SERIES LB CONOMOTOR CONTROL VALVES

Great strides have been made in recent years in the fields of instrumentation and automatic control. Most consideration has been given to primary elements, signal transmission and control instruments. But, not much has been done to radically change the *final control element.*

In the past decade Conoflow has made many contributions to the field of Final Control Elements by the development of pneumatic operators for throttling control service. Today, the Conoflow LB Control Valve represents one of the greatest forward steps in control valve design. We believe it heralds a new era of original thinking in keeping with the modern standards of the completely automatic plant.

The LB Conomotor Control Valve features a new type of pneumatic operator with ability to *sense* and *position*, and with *power* to operate under sudden load changes. It is mechanically sound with reliable *accuracy* and *stability.* It combines a new design of the already approved Conomotor Cylinder operator with a single seated, split body, integral bonnet valve, with an honest-to-goodness renewable seat ring and a fully guided plug and stem assembly. Result . . . the optimum in control and dependability.

Tho designed for the processing and power industries, Cylinder Conomotor Valves are finding application in hundreds of services that demand accurate and trouble-free control of a wide variety of fluid flows. Chances are, this is the all-important final link you have long sought for your control loop. It's worth talking over . . . Just write or phone today.

Write for Catalog LB-1, heralding this new "Step Ahead in Cybernetics."

Conic Controls

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Foremost Manufacturers of Final Control Elements

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DEKORON IMPERVAPAK

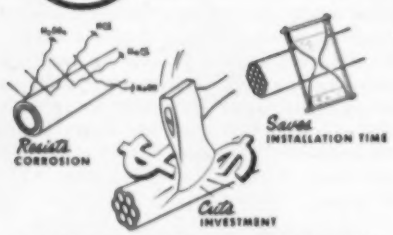
the instrument line harness that cuts tubing installation costs up to 50%

Worried about high instrument tubing installation costs? Then Dekoron Impervapak—the *corrosion-proof* instrument tubing harness—is just what the cost analyst ordered.

With Dekoron Impervapak there's no need to laboriously install instrument lines one at a time. Users say seven-tube Impervapak harness can be installed as rapidly as two single lines of ordinary instrument tubing. Savings are correspondingly greater with 10, 14 or 19-tube harness. Compact construction makes the installation neat and less subject to mechanical damage; no special brackets are needed.

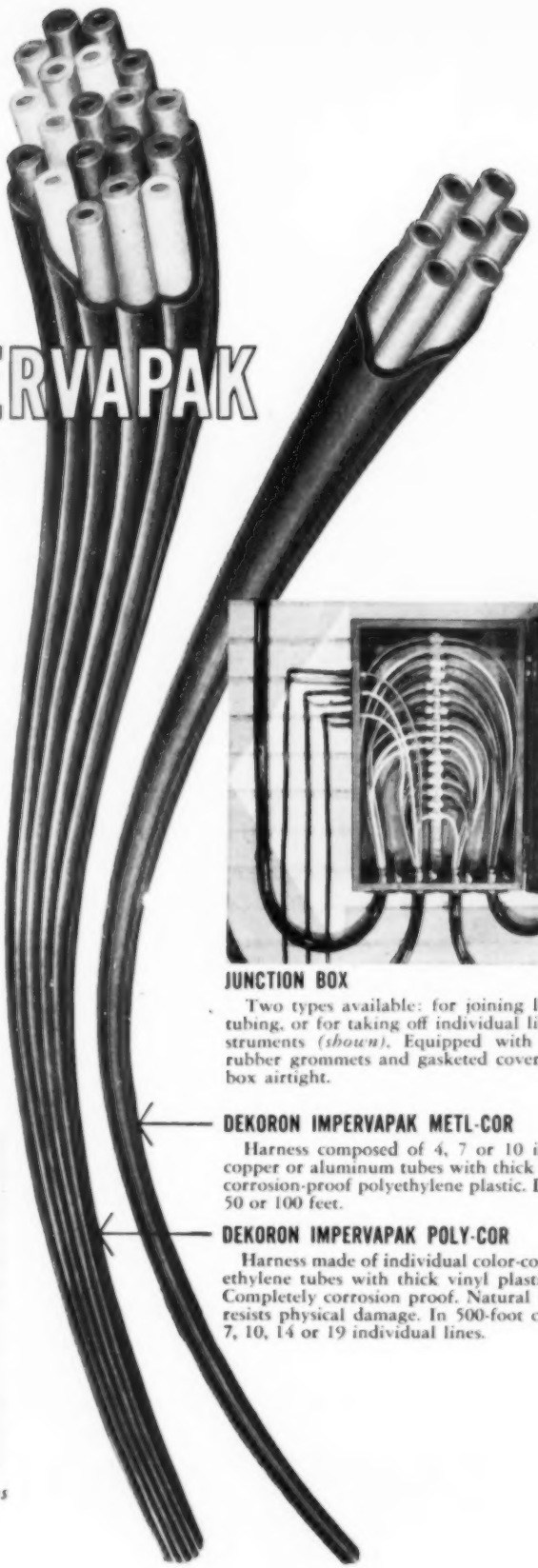
And perhaps most important of all, *Dekoron Impervapak is impervious to attack from even the most severe industrial atmospheres or weather conditions.*

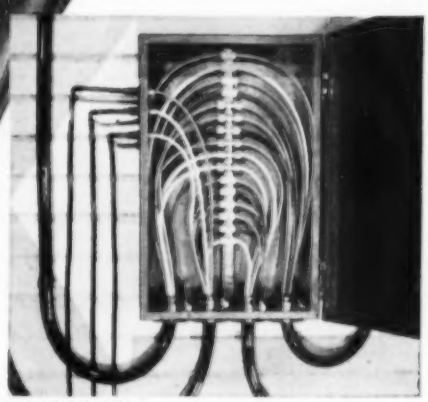
Dekoron® tubing



SAMUEL MOORE & COMPANY
DEKORON TUBING DIVISION • MANTUA, OHIO

Send for your free copy of Bulletin L-6506 "3 Ways to Whip Corrosion and High Tubing Installation Costs in Your Plant."





JUNCTION BOX

Two types available: for joining lengths of tubing, or for taking off individual lines to instruments *(shown)*. Equipped with synthetic rubber grommets and gasketed cover to make box airtight.

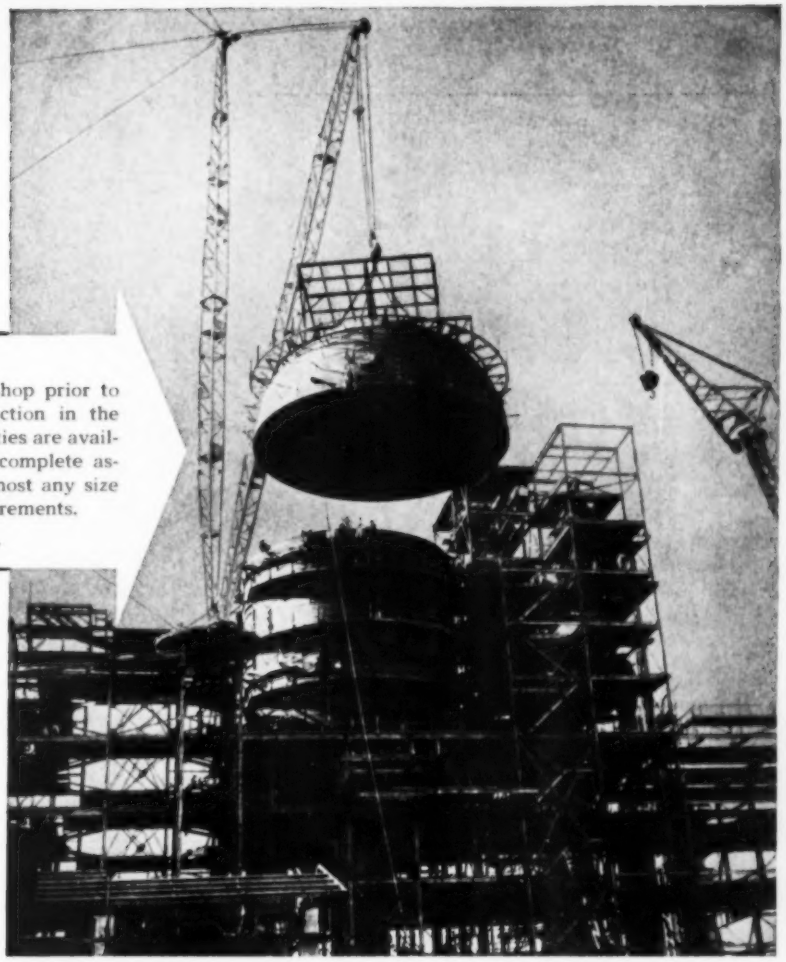
DEKORON IMPERVAPAK METL-COR

Harness composed of 4, 7 or 10 individual copper or aluminum tubes with thick sheath of corrosion-proof polyethylene plastic. In coils of 50 or 100 feet.

DEKORON IMPERVAPAK POLY-COR

Harness made of individual color-coded polyethylene tubes with thick vinyl plastic sheath. Completely corrosion proof. Natural resiliency resists physical damage. In 500-foot coils of 4, 7, 10, 14 or 19 individual lines.

A-6438



Precision assembly in the shop prior to shipment expedites construction in the field. Cranes and other facilities are available at Newport News for complete assembly of weldments of almost any size to meet the customer's requirements.

Shipbuilder "launches" new vessel

It's a pressure vessel in an overseas petroleum refinery. And it caps *sixty-seven* years' experience by the Newport News Shipbuilding and Dry Dock Company. Sixty-seven years, building just about any kind of vessel you could name. And at a price.

They've fabricated millions of tons of steel. They handle weldments in almost any size or shape. They machine, weld and stress relieve.

Another development: fabrication of corrosion-resistant alloy, clad, and other special steels. You know how important they are today.

What's more, there's plenty of equipment – foundry, machine shop, fabrication and erecting – to build anything from a cat cracker to a bubble tray. And enough engineering skill and shop force experience to handle the job as you want it done. And at reasonable cost.

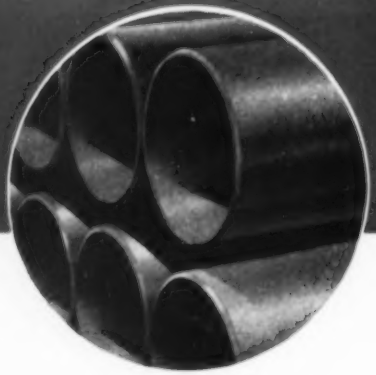
It would pay you to ask yourself, "What could Newport News build for us?" Find the answer in the brief, easy-to-read, photo-and-caption pages of *Facilities and Products*. See for yourself what Newport News is doing. And what equipment they use.

Send for *Facilities and Products*, free, today!

NEWPORT NEWS

SHIPBUILDING AND DRY DOCK COMPANY
Newport News, Virginia

Ladish Flanges



J&L Pipe — A.S.T.M. A-53 and A.S.T.M. A-106

Walworth Valves

HOW J&L SERVES PETROCHEMISTRY!

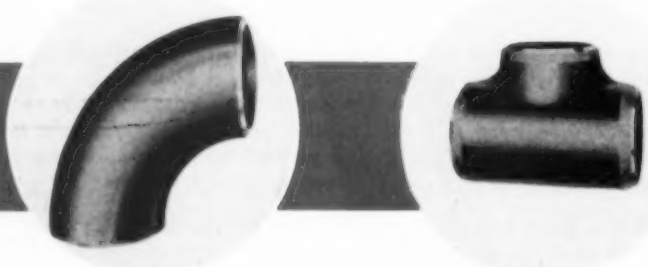
Inquiries and orders from men in refining, natural gasoline and petrochemistry are intensely interesting and important to us.

You will never waste an inquiry or an order on J&L. A growing knowledge of your needs and preferences are building blocks we use to improve and expand store stocks, warehouse inventories, and manufacturing connections.

The J&L concept of service and availability is aggressive and responsive. An inquiry from you today or tomorrow or next week may trigger a chain reaction involving stores, warehouses and factories across this nation and Canada.

Pick up your 'phone and call that J&L number now! You serve yourself when you allow us to serve you—and that is the way it should be.

Midwest Welding Fittings

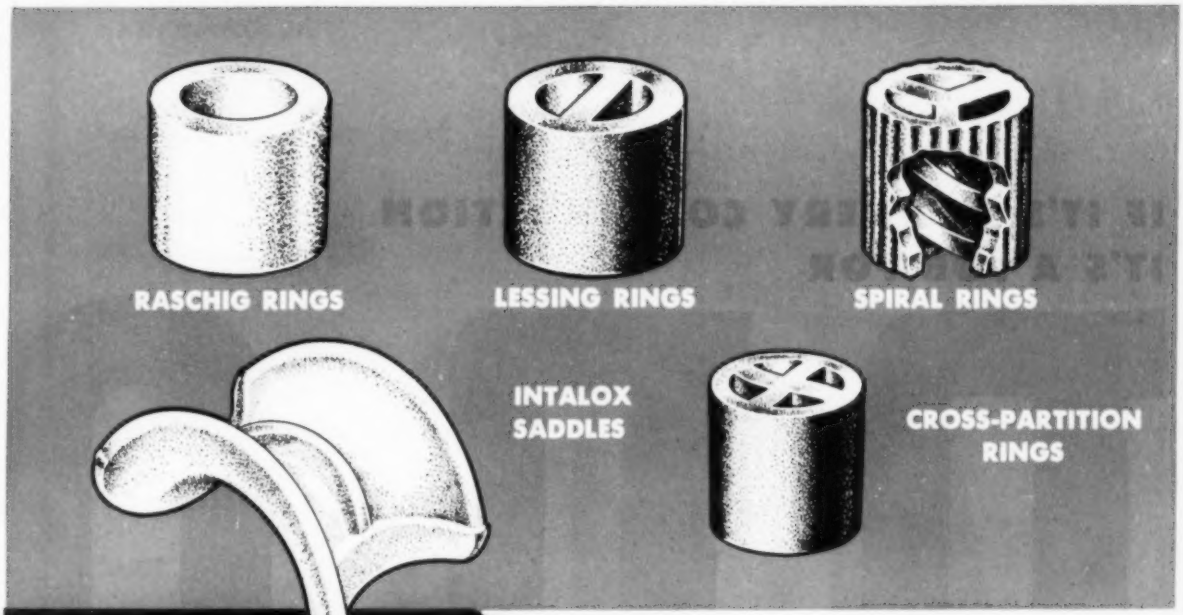


J&L STEEL

JONES & LAUGHLIN STEEL CORPORATION
SUPPLY DIVISION

Serving The United States and Canada
General Offices: TULSA, OKLAHOMA
J&L Tubular Products and Wire Rope

PESA
PARTNERS IN PETROLEUM PROGRESS



TOWER PACKING

U. S. Stoneware offers a range of types and sizes of Tower Packings not even remotely approached by any other manufacturer . . .

INTALOX SADDLES
Unique design minimizes "pattern" packing, blocking, or nesting in dumped beds. Appreciably greater surface area. Lower pressure drop. Higher flooding limits. Made in ½" ¼", 1", 1½" and 2" sizes in both high-fired chemical porcelain and chemical stoneware.

RASCHIG RINGS
Low initial cost. Most widely used of all tower packings. Made in chemical porcelain, chemical stoneware, carbon, steel and other alloys. Size range from ¼" to as high as 6", depending upon material. Sizes up to 2" are generally dumped. Larger sizes, stacked.

LESSING RINGS
A modification of the Raschig Ring. The ring has a single partition or web added to the inside. Made in 1", 1¼", 1½" and 2" sizes in chemical porcelain or chemical stoneware. Usually dumped.

CROSS-PARTITION RINGS
A further modification of the Raschig Ring. Two inside webs cross each other at right angles to create a "4-cell" ring. Cross-Partition rings are made in 3", 4" and 6" sizes in chemical stoneware. They are usually stacked in the tower.

SPIRAL RINGS
Made in single, double or triple spiral types. The function of the spirals is to increase the turbulence of the gas stream. Made in chemical stoneware in 3¼", 4" and 6" sizes. Spiral rings are used in stacked beds.

All U. S. Stoneware ceramic tower packings are made from bodies especially developed for tower service. They are extremely tough, possess high resistance to spalling and exceptional corrosion-resistant properties. Chemical porcelain bodies are completely iron-free and are of zero porosity.

E11-D

The U. S. STONEWARE Co.
AKRON 9, OHIO

IF IT'S REFINERY CONSTRUCTION
IT'S A JOB FOR

PLATFORMING UNITS

CATALYTIC CRACKING UNITS

GAS RECOVERY UNITS

POLYMERIZATION UNITS

THERMAL CRACKING UNITS

CRUDE UNITS

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VIS-BREAKING UNITS

GASOLINE PLANTS

TREATING PLANTS

CHEMICAL PLANTS

L.P.G. UNITS

STEAM GENERATING PLANTS

COOLING TOWERS

OFFICE, PLANT AND
LABORATORY BUILDINGS

CON

PROCON *Incorporated*
PROCESS CONSTRUCTION
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IN ENGLAND
PROCON (*Great Britain*)
LIMITED
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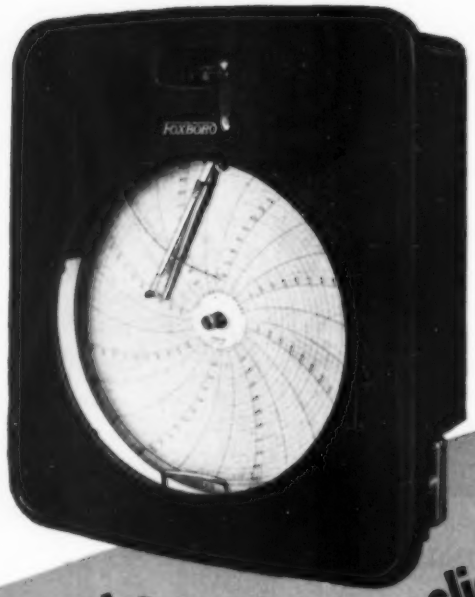
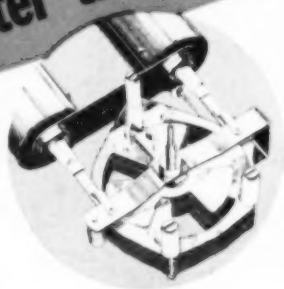
PROCON

An unbeatable pyrometer for any range between -300° and +2800°F.



DYNALOG* ... the electronic potentiometer that has no slidewire!



This simple variable capacitor is important to potentiometer users because it eliminates the conventional, troublesome slidewire altogether; and it gives Dynalog Instruments the continuous *stepless* balancing which assures higher accuracy, closer control.

*Reg. U.S. Pat. Off.

. . . no batteries to standardize!

TOPS in simplicity . . . unequalled in its combination of accuracy, sensitivity, and speed of response . . . the Dynalog Potentiometer with standard thermocouples gives you unerring temperature measurement for any range up to 2800°F. Featuring *sustained* accuracy of ¼ of 1% of scale, it's an instrument of laboratory precision built to withstand the severest industrial conditions.

Unprecedented freedom from maintenance is the direct result of unique Dynalog design. There's no slidewire, no battery to standardize. There are no gears, belts, or high speed reversing motors. There's nothing to wear and cause dead space.

Single pen recording models provide full scale pen travel in 3 seconds standard, or as fast as 1 second without extra cost. The Multi-Record Dynalog provides color-coded records of up to 6 points at 6 second intervals. Both types give the convenience and low cost of circular charts.

Dynalog Potentiometers are also used for the measurement of pH, oxidation-reduction potential, and for other applications in which the process variable can be converted to a dc millivolt signal. They are available for pneumatic or electric control.

Write for your copy of Bulletin 427-1 which gives the whole story.

THE FOXBORO COMPANY, 7411 NEPONSET AVE., FOXBORO, MASS., U.S.A.

FOXBORO REG. U.S. PAT. OFF. **POTENTIOMETERS**

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

puts the HEAT on heat exchangers

By changing to Yarway Impulse Steam Traps, an oil refinery reports much hotter steam in their heat exchangers **—plus two other important extras:**

(1) They were able to operate the plant with 6 boilers instead of the 8 formerly required.

(2) Three men formerly required to service old-type traps can now be used for productive work.

Significant sidelight—these Yarway traps are operating under severe conditions, many outdoors with temperatures often below zero.

Plant after plant is standardizing on Yarway Impulse Steam Traps because Yarways are designed to deliver the most premium B.T.U.'s at top temperatures into your process or product. **They get equipment hotter, sooner ... and keep it hot.**

Other reasons—small size, easy installation, good for all pressures, only one moving part, low maintenance, low price.

Buy your Yarway Impulse Steam Traps from the nearest of 216 distributors. For name, write us.

ACTUAL SIZE ¾" YARWAY STEAM TRAP

YARNALL-WARING COMPANY
128 Mermaid Ave., Philadelphia 18, Pa.

FREE OFFER. Don't take our word for it. Test Yarway's advantages in your own plant, without cost or obligation. Drop us a card or letter—a trial trap will be delivered promptly.

YARWAY the steam trap
designed with more production in mind

STRONG...
TOUGH...
ECONOMICAL...

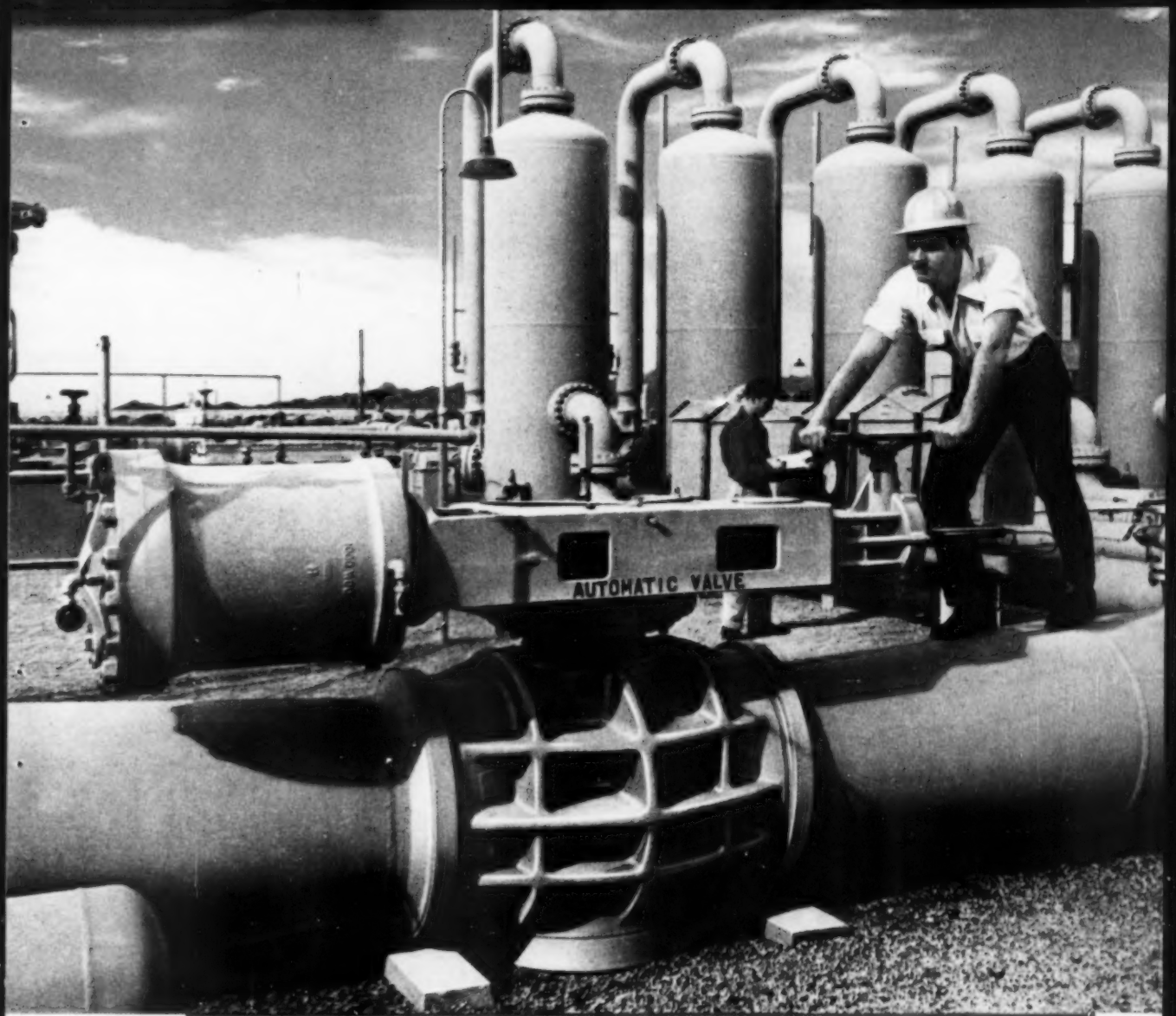
Republic Upson Alloy Steel Studs

Accurate, uniform threads of Republic Upson Alloy Steel Studs assure full-engaged thread area—combine with the high strength and toughness of alloy steels—to provide maximum holding power under severest conditions of pressure and temperature.

Thousands of Republic Upson Alloy Steel Studs are helping keep all types of pressure equipment on-stream . . . are lengthening the time between costly stud replacements.

REPUBLIC STEEL

REPUBLIC STEEL CORPORATION
Bolt and Nut Division
CLEVELAND 13, OHIO
Export Department:
Chrysler Building, New York 17, N.Y.



Lubricated INSURANCE POLICY

Ever hear of a lubricated insurance policy?

That's really what you're buying when you install power operated Nordstrom valves. You're buying *Prevention* and *Control*.

Prevention, because in a Nordstrom protective lubricant seals tighter than any other method, yet makes a sliding contact surface for instant easy operation on a quarter turn.

Control, because Nordstrom valves can be equipped for electric, hydraulic or pneumatic operation, with automatic, manual or remote control.
Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL Built **Nordstrom Valves**

Lubricant-Sealed for Positive Shut-Off

Another Rockwell Product

Lubricant makes a valve easier to operate, just as it will nearly any mechanical device. But that's far from its only function in a

NORDSTROM....

A system of internal grooves deposits a seal of lubricant, under pressure, around each port to prevent both internal and external leakage.

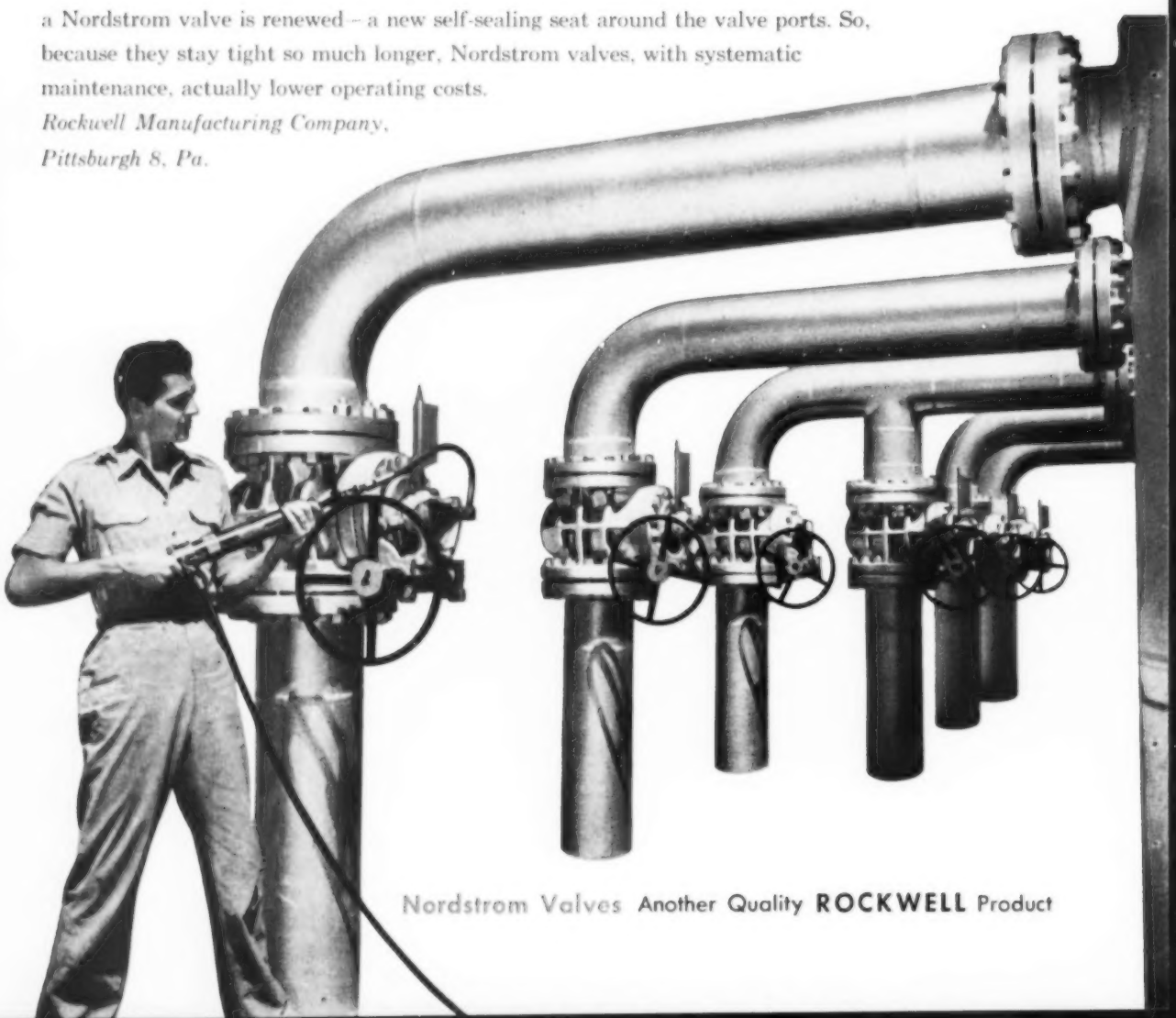
A NEW VALVE

properly maintained, stays new for many years—always tight, always ready to operate in an emergency, because the lubricant in a Nordstrom valve keeps erosion-producing seepage from starting in the first place, filling the smallest scratch on the seating area with a film of plastic sealer.

EVERY TIME IT'S LUBRICATED

a Nordstrom valve is renewed – a new self-sealing seat around the valve ports. So, because they stay tight so much longer, Nordstrom valves, with systematic maintenance, actually lower operating costs.

Rockwell Manufacturing Company,
Pittsburgh 8, Pa.



Nordstrom Valves Another Quality **ROCKWELL** Product

The tanker was in flames with 160,000 barrels of high octane gas aboard!

It ignited when it collided with another tanker in the Delaware River. A ten-man Navy team, from damage control training center, Naval Base, Philadelphia, under the direction of Lieutenant Commander Louis O. Lindeman, came to the rescue in the tug U.S.S. Toka. Using Rockwood fire-fighting equipment, here is what they did:

NAVY FIRE FIGHTERS using a Rockwood FFF FogFOAM Nozzle direct FOAM into the deck and holds of the burning tanker. Note blanket of FOAM on aft deck.

APPROACHING TANKER, Navy Fire Fighters discharge FogFOAM Nozzles on deck of burning tanker extinguishing fire and cooling deck permitting men to board tanker to put out fire in hold.

MEN ON TUG cool tanker deck with Rockwood FOAM discharged from Rockwood 2½" FFF FogFOAM nozzle. Note FOAM on men, protecting them from intense heat.

THE FIRE IS OUT and 92% of the cargo saved! During fire-fighting, FOAM was also pumped into tanks below deck. Entire operation took 6 hours. Tanker in distance was cause of fire.

GET MORE FACTS about Rockwood equipment by writing for the informative, 12-page booklet "Rockwood Fire Fighting Products." Rockwood Sprinkler Company, Portable Fire Protection Division, 102 Harlow St., Worcester 5, Mass.

ROCKWOOD SPRINKLER COMPANY

Engineers Water . . . to Cut Fire Losses

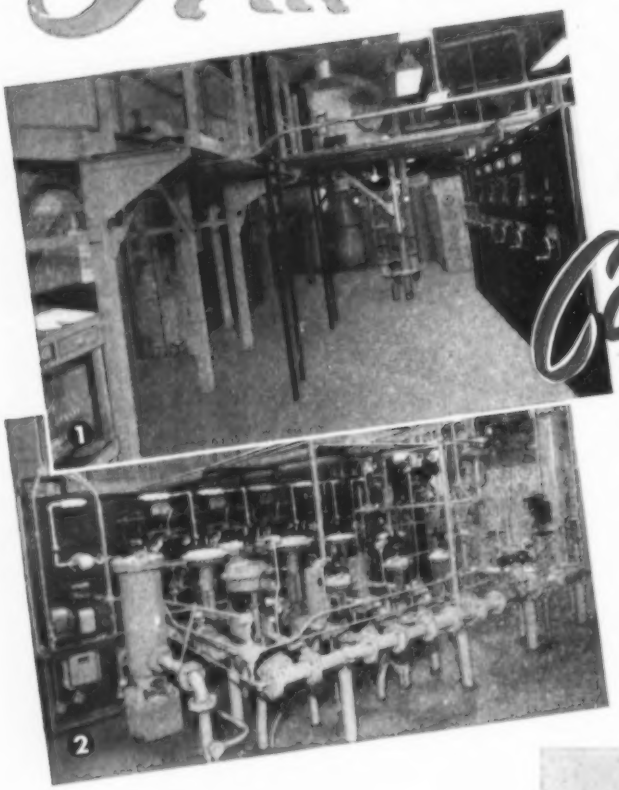
ROCKWOOD

Portable Fire Protection Division

SINCLAIR *INCREASES OUTPUT...*

...with % PROPORTIONEERS %

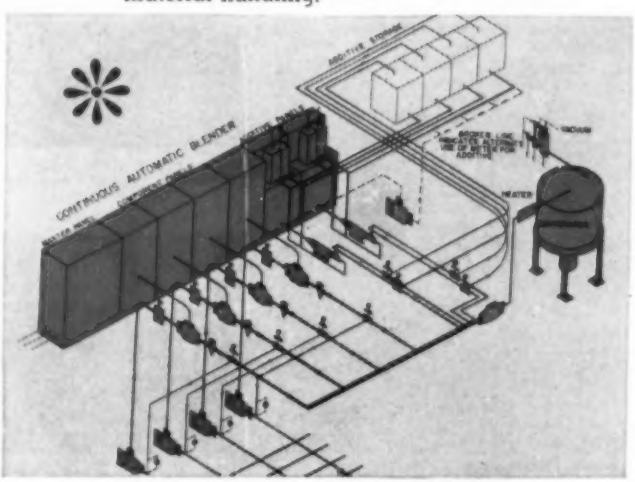
Automatic Compounding



This new %Proportioneers% installation at the Marcus Hook plant of Sinclair Refining Company utilizes phase control between components of lube stocks to reduce batch blending to completely automatic compounding. %Proportioneers% recirculation method permits exact presetting and control of component and additive ratios and allows quick adjustment of the total rate to production requirements without affecting these ratios. %Proportioneers% Continuous, Automatic Compounding makes possible greater flexibility between small and large quantity production with increased operating efficiency and new economies in material handling.

❶ %Proportioneers% compounding panels at right, additive storage upper left, and flash evaporator in background.

❷ Back side of compounding panels showing control valves, recirculation system, and blend manifold.



All equipment shown red in flowgram furnished by %Proportioneers, Inc.%

For complete information ask for Brochure SM-138

% PROPORTIONEERS, INC. %

412 HARRIS AVE., PROVIDENCE 1, RHODE ISLAND

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries. Consult your telephone directory or write to %Proportioneers, Inc.%

NEW, LOW-COST EFFICIENCY

Clark DUO-STEP Leverage

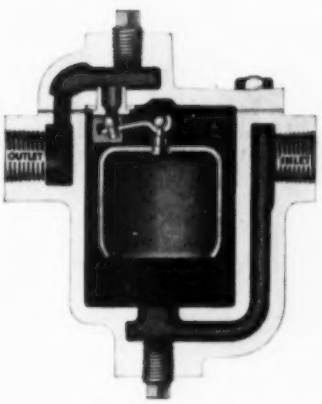
FAMOUS DUO-STEP LEVERAGE IS NOW AVAILABLE FOR THE FIRST TIME ON THESE SMALLER SIZED STEAM TRAPS. GET HIGHEST DRAINAGE CAPACITY AT LOWEST COST.

● Duo-Step is the revolutionary double fulcrum principle that affords maximum leverage to "crack" the valve from the orifice seat, teamed with "Follow-through" power that opens the orifice completely. This double action actually gives you double the drainage capacity of ordinary steam traps.

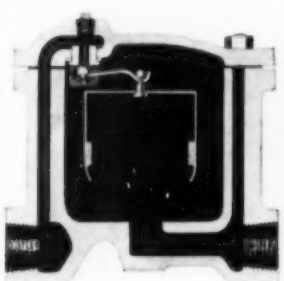
Model 60-D traps are of cast semi-steel construction, designed for pressures up to 200 P.S.I. and temperatures to 400° F. Duo-Step levers and brackets of stainless steel construction. Seats and discs are of Clark-loy. ½" or ¾" horizontal inlet and outlet connections with ¼" test outlet and drain plug. Vertical inlet can be furnished in ½" or ¾" size.

Model 70-D traps are of cast semi-steel construction, designed for pressures up to 200 P.S.I. and temperatures to 400° F. All working parts of stainless steel construction. Seats and discs are of Clark-loy. Horizontal inlet and outlet connections located at bottom of trap body for close-to-the-floor installations.

Model 70-TD for pressures to 150 P.S.I. and temperatures to 375° F. is available WITH BUILT-IN THERMAL BY-PASS at additional cost.



CLARK 60-D TRAP



CLARK 70-D TRAP

FOR COMPLETE INFORMATION CONTACT YOUR CLARK REPRESENTATIVE OR WRITE FOR *NEW* DUO-STEP BROCHURE

THE HOME OF DUO-STEP LEVERAGE

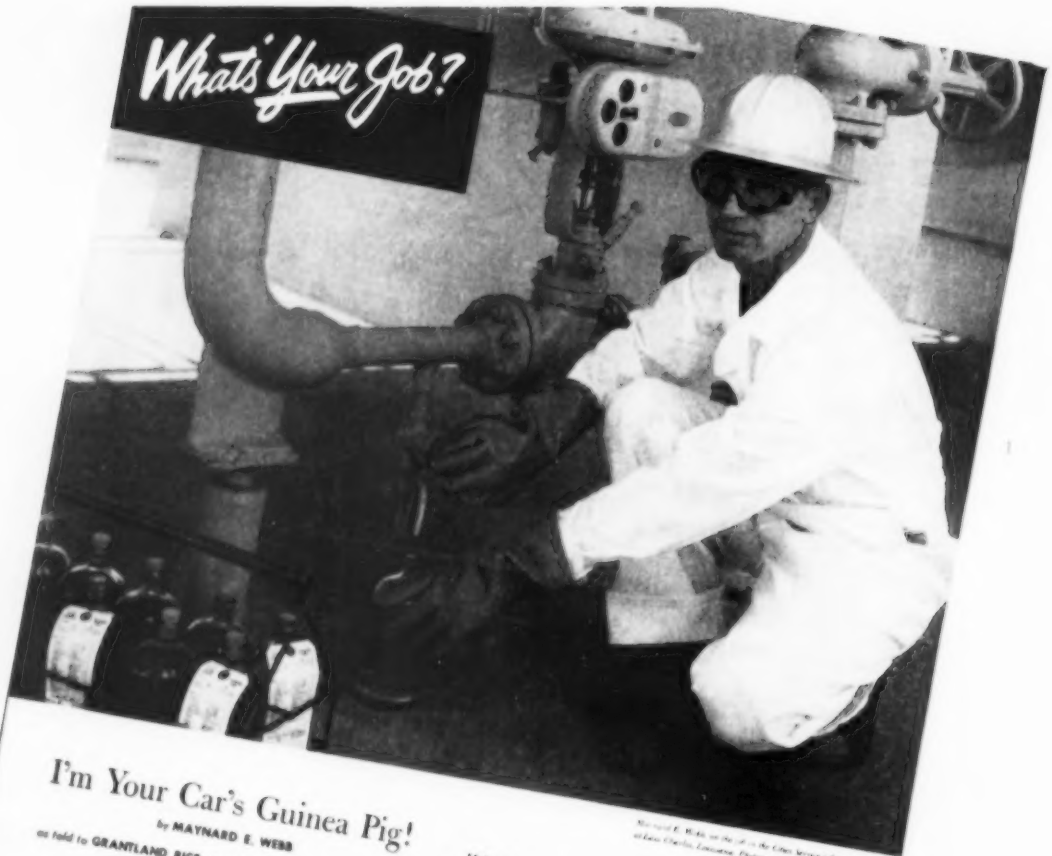
Clark

MANUFACTURING COMPANY

1830 EAST 38th STREET

CLEVELAND 14, OHIO

Distributors and Representatives in all major cities



I'm Your Car's Guinea Pig!

by MAYNARD E. WEBB

as told to GRANTLAND RICE, Noted Sportswriter and Commentator

THEY TRY OUT the gasoline ... If our reaction ...

... every 15 minutes, test up to 20 different ways, and report our findings.

We couldn't be fussier if we were making baby food.

Making gasoline is a lot like making baby food, at the ... compression engine is as sensitive to ... formula. When a baby ...

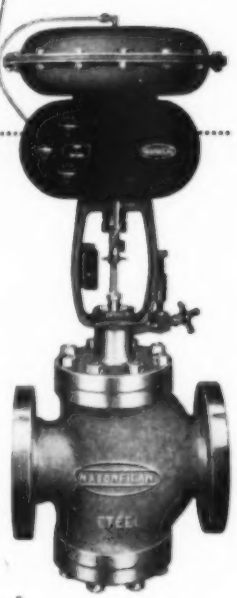
... care we take to turn out a fine gasoline. A book could be written on the subject. But I think you'll agree that we guinea pigs are probably the most important people in this refinery—from your car's point of view, that is.

CITIES SERVICE

Masoneilan 10000 Series Valve and 7000 Series Positioner at work in Cities Service refinery at Lake Charles, Louisiana

If your job is selecting Control Valves

get acquainted with the quality features which distinguish *Masoneilan* Control Valves. Learn about the built-in accuracy, stamina and economy which has induced thousands of quality-conscious companies like Cities Service, all over the world, to select Masoneilan valves as an important element in maintaining the quality of *their* products. Put Masoneilan Control Valves to work for you — helping maintain the quality of *your* product. Complete information on request.

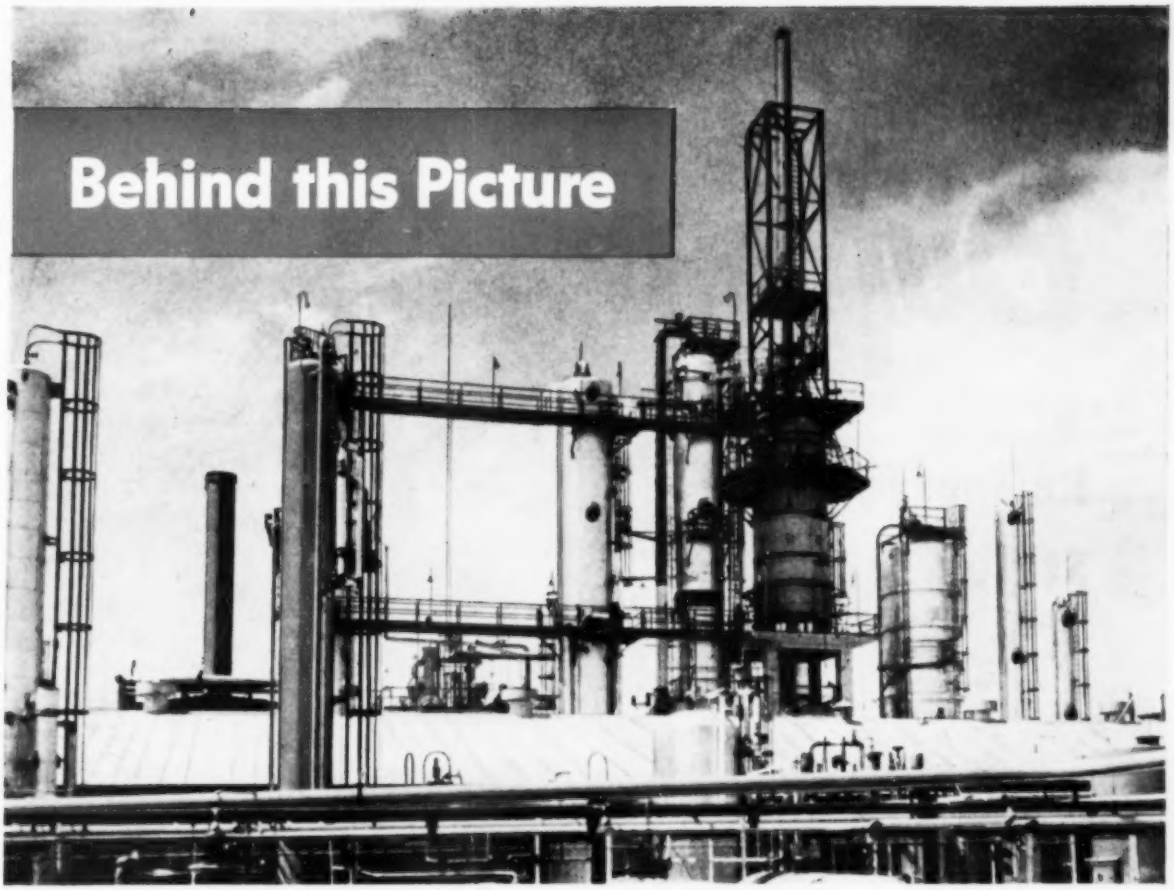


Industrial Controls MASONEILAN *Specialists Since 1882*

MASON-NEILAN
REGULATOR CO.

1182 ADAMS STREET, BOSTON 24, MASS., U. S. A.

Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis • Tulsa • Philadelphia Houston • Pittsburgh • Atlanta • Cleveland • Cincinnati • Detroit • San Francisco • Boise • Louisville Salt Lake City • El Paso • Albuquerque • Charlotte • Los Angeles • Corpus Christi • Denver • Appleton Birmingham • New Orleans • Dallas • Seattle • Mason-Neilan Regulator Co., Ltd., Montreal and Toronto



. . . a New Concept in Refinery Design

Up there is part of the new refinery at Wrenshall, Minnesota that we designed and built for International Refineries, Inc. With a capacity of 11,000 B/D, the new plant produces gasolines, and a wide range of fuel oils for home and industry.

Ultra-modern Wrenshall features single-unit construction. Distillation, Model IV Fluid Catalytic Cracking, gas recovery, treating, and polymerization are all combined in a single unit. The plant is a model of integrated processing—balanced to meet the needs of the area it serves.

This unique design lends itself to continuous flow and automatic control—so you'll also find these at Wrenshall. From crude charge to end products, flow of oil is continuous, doing away with intermediate storage, pipes, pumps and tanks. And it takes just three men, at one centralized station, to completely control the processing of the entire refinery.

What does all this mean? To International, it means a very substantial reduction in initial investment and operating costs. To us, it means another in a long list of jobs where we worked out new answers—used creative imagination.

Perhaps we can be of help on *your* next project.

THE LUMMUS COMPANY

385 MADISON AVENUE, NEW YORK 17, N. Y.

HOUSTON • CHICAGO • LONDON • PARIS • CARACAS

DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

"Big Top"

Refinery Style

". . . floats through the air with the greatest of ease . . ." well describes this big-top aerial performer—the cap for an oil-refining pressure vessel 55 feet in diameter. Very much in the act are Sun Ship's riggers and crane operators. They have had long experience in handling giant assemblies and heavy machinery for petroleum refineries, chemical plants, and the many other industries Sun Ship's versatile shops serve by mastering problems of plate work, fabrication, and construction of special machinery.

There's a lot of skilled hard work behind a successful circus act . . . and behind a successful engineering job. Setting a giant pressure vessel's cap in place is just one phase of the job shown above. After these heads are fabricated, assembled, and welded into large sections, the joints of the sections are X-rayed. When "Sun Ship O.K.'d," the head is dismantled for shipment to the refinery.

The building and shipping of such immense special structures give a practical demonstration of how Sun Ship's versatile facilities and engineering know-how are coordinated in serving many industries . . . and how they can build practically any metal equipment needed in industry's task of building a greater America.

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE (SINCE 1916) **CHESTER, PA.**

25 BROADWAY • NEW YORK CITY

PUMPS

for PETROLEUM

FLUID POWER PUMPS

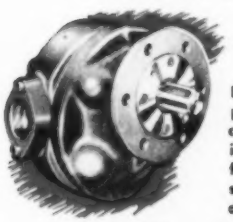
in equipment and vehicles required for modern exploration, drilling, production, piping and refining of petroleum. Here is a most comprehensive range of sizes, types capacities and pressures from 0 to 1500, 2000 and 3000 psi together with hydraulic motors, valves and cylinders for developing complete hydraulic circuits. Here is power which combines safety, flexibility, limitless variations and sound economy . . . hydraulic power at its best.

LIQUID HANDLING PUMPS

Virtually "any substance that will flow through a pipe," including petroleum products from naphthas to crudes and acid sludge, can be efficiently and economically handled in small or bulk quantities by Pumps available from this single source. There are deep and shallow well Centrifugal and Turbine Types, Rotating Plunger and Herringbone Pumps embracing a very broad range of types, sizes and constructions.

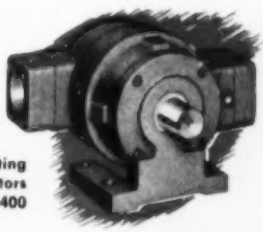
VACUUM PUMPS

High vacuum pumps for laboratory or high production service in research, vacuum distillation, refrigeration, dehydration, chemical processing, de-aerating, etc.



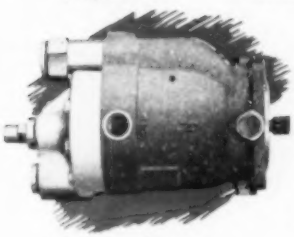
HYDRECO
GEAR TYPE PUMPS

Reversible and non-reversible. Gear type pumps in exclusive FOUR-BOLT design . . . capacities from .5 to 130 gpm and operating pressures to 1500 psi . . . flange or foot mounted . . . furnished with keyed shaft with spline shafts optional. Also dual and tandem models.



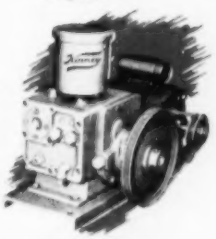
DUDCO
DUAL VANE TYPE PUMPS

DUDCO Pumps provide a broad range of sizes with capacities to 120 gpm and pressures to 2000 psi. Also available in dual units operating from a single drive. Hydraulic motors with starting torque outputs to 14,400 lb. in.



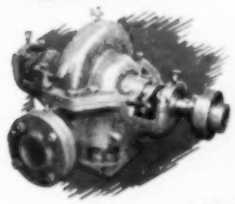
STRATOPOWER
PISTON TYPE PUMPS

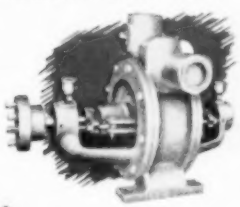
Axial reciprocating piston type . . . constant or variable delivery with capacities of .25 to 10 gpm at nominal speeds of 1500 rpm with maximum of 4500 rpm . . . working pressures to 3000 psi . . . direct engine and individual electric motor driven models.



KINNEY
VACUUM PUMPS

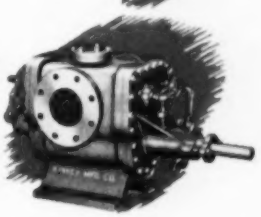
Single stage models to produce absolute pressure readings of 10 microns (.01 mm Hg.) . . . compound pumps producing readings of .2 microns (.0002 mm Hg.) or better. These Kinney High Vacuum Pumps are available in sizes for laboratory as well as high production use.





AURORA
CENTRIFUGAL & TURBINE PUMPS

Deep well, sump, drainage and condensation return units, household water systems. Industrial low and high pressure liquid handling pumps. Direct motor and countershaft driven horizontal and vertical models. Capacities 3 to 7500 gpm.



KINNEY
LIQUID HANDLING PUMPS

A complete range of sizes in Rotating Plunger and Herringbone Gear Pumps to handle light or heavy liquids, from gasoline to asphalts. Available in plain or steam jacketed models.

THE NEW YORK AIR BRAKE COMPANY
230 PARK AVENUE • NEW YORK 17, N. Y.

THE NEW YORK AIR BRAKE COMPANY
230 Park Ave., Dept. PR, New York 17, N. Y.

Gentlemen: Kindly send me additional information on: Hydraulic Pumps ☐ 1000 psi ☐ 2000 psi ☐ 3000 psi Liquid Handling Pumps ☐ Vacuum Pumps ☐

Name.....

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City..... **State**.....

40 YEARS KNOW-HOW
in making blue prints come true
...20 years in Houston

TEXAS PIPE BENDING COMPANY

PIPE BENDS
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WELDED HEADERS

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HOUSTON TEXAS

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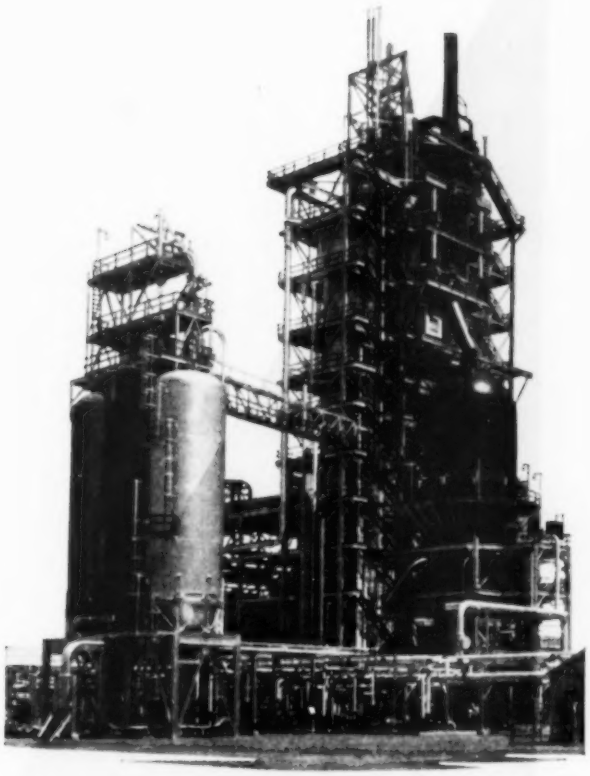
301 FRIO STREET
WOODCREST-6-2659

This Well Known Billings, Montana, Refinery

uses A. P. GREEN CASTABLE

SK-7 and KS-4

in the Regenerator of its Cat Cracking Unit



SK-7 and KS-4 were used to form a compact monolithic lining in the regenerator of this cat cracking unit at Billings, Montana. In operation over two years . . . it is giving excellent service.

SK-7 and KS-4 offer 4 Outstanding Advantages . . .

1. Cuts construction time and labor costs.
2. Reduces rebound loss.
3. Is adaptable to a variety of installations.
4. Results in linings with balanced characteristics of poured castables.

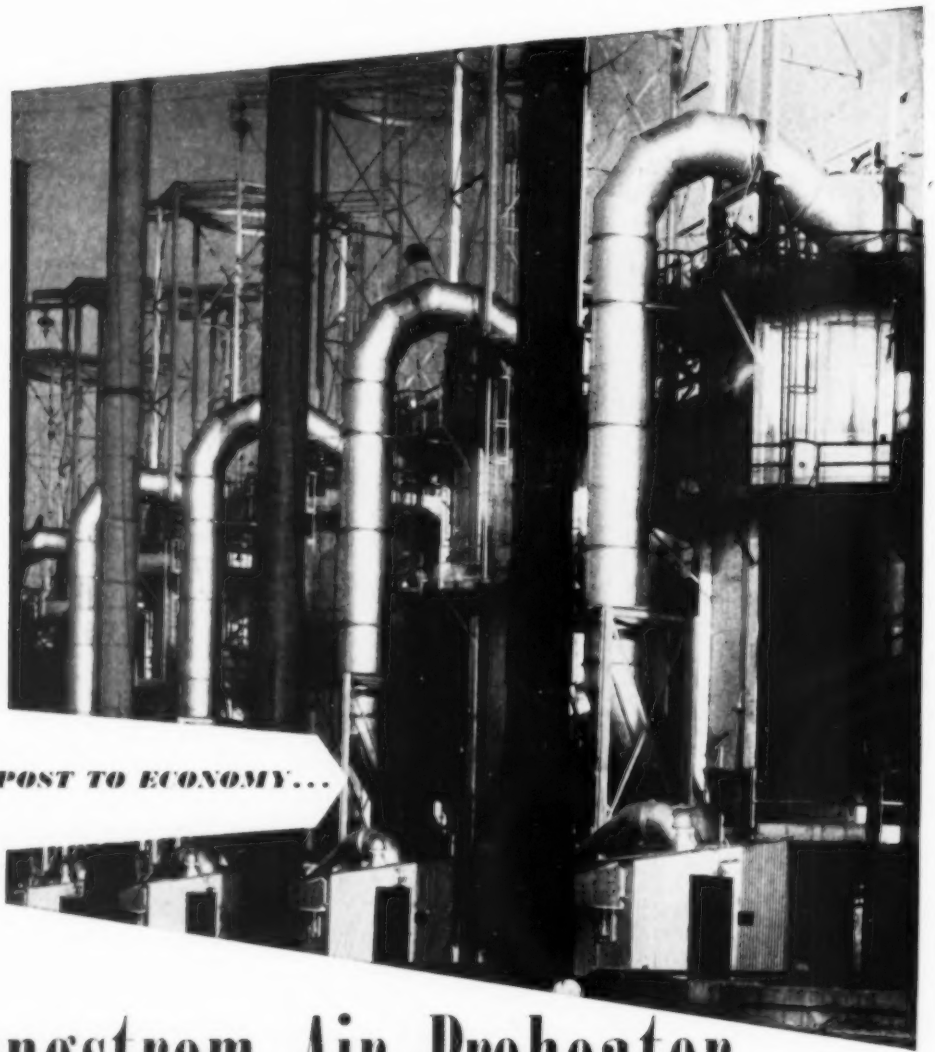
A. P. Green SK-7 and KS-4 are two great new castable refractories, offering all the advantages of ordinary castables and, in addition, may be "gunned" in place by means of a cement gun. This fast, simple method of installation lowers construction and maintenance costs.

SK-7 and KS-4 were designed for use in combination. They form a composite monolithic lining and are the answer to the demands for castable refractory and insulating castable linings for unusually shaped equipment — the contour of which does not lend itself to the application of normal pouring castables.

A. P. Green REFRACTORY PRODUCTS

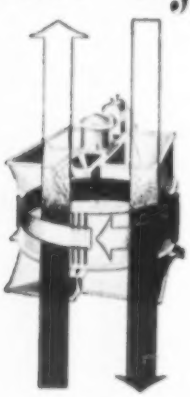
A. P. GREEN FIRE BRICK CO.
Mexico, Missouri, U. S. A.
In Canada
A. P. GREEN FIRE BRICK CO., LTD.
Toronto 15, Ontario
Distributors in the Principal Cities of the World

For detailed information concerning these castable refractories, write the Engineering Department of the A. P. Green Fire Brick Company . . . or call your local A. P. Green Distributor.



GUIDEPOST TO ECONOMY...

The Ljungstrom Air Preheater



The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

Every year, the process industries consume hundreds of millions of barrels of fuel. Refineries alone, for example, use up more than 200,000,000 barrels annually for processing crudes. This vast quantity of fuel represents probably the *greatest single item* in operating expense. If lower costs are to be realized, serious thought must be given to heat-conservation equipment.

The Ljungstrom Air Preheater offers the process industries a chance to save as much as *20% of the fuel needed for process work*. This fuel saving, plus the added benefit of increased production, makes the Ljungstrom an eminently practical piece of equipment to be considered wherever fuel is burned.

Check today to see how the Ljungstrom Air Preheater will pay for itself in just a few months – and give you impressive savings for years to come. Call or write The Air Preheater Corporation for full details.

Wherever You Burn Fuel, You Need Ljungstrom

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

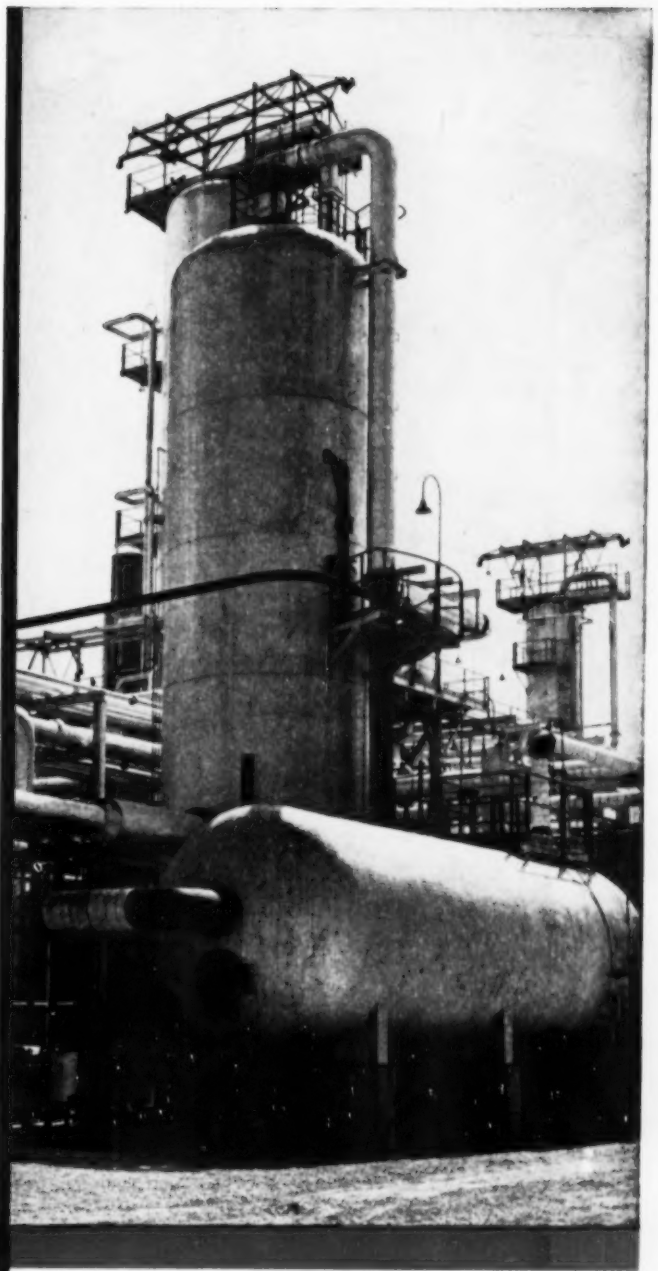
WHEN YOU NEED *Desalting*

BE SURE YOU GET SERVICE

Desalting, like any other refining process, should be designed, supervised and serviced by specialized experts. Many years of chemical desalting experience have convinced the Tretolite Company desalting engineers that complete service is necessary if efficient desalting is to be attained. Since the Tretolite Company pioneered chemical desalting, and since Tretolite currently is being used to desalt over a million and a half barrels of crude per day, we believe that these conclusions have a factual foundation.

The attainment of efficiency in chemical desalting just begins with the preliminary tests, specification and sale of the treating chemical. The treating plant must be designed to give the most efficient flow, proper heating, correct contacting and necessary residence time. All these are factors of design — important factors with which Tretolite desalting engineers are fully conversant.

At Tretolite, we believe that we can *sell* you the best desalting chemicals available; we will *give* you the best service.



Tretolite Desalting Service provides:

1. **Preliminary performance-prediction tests**
2. **Plant design assistance, drawings and consultation**
3. **Construction advice and supervision**
4. **Technical assistance for the "start-up"**
5. **Instruction of refinery personnel**
6. **Continuing service and periodic inspections**

DON'T BE SATISFIED WITH LESS

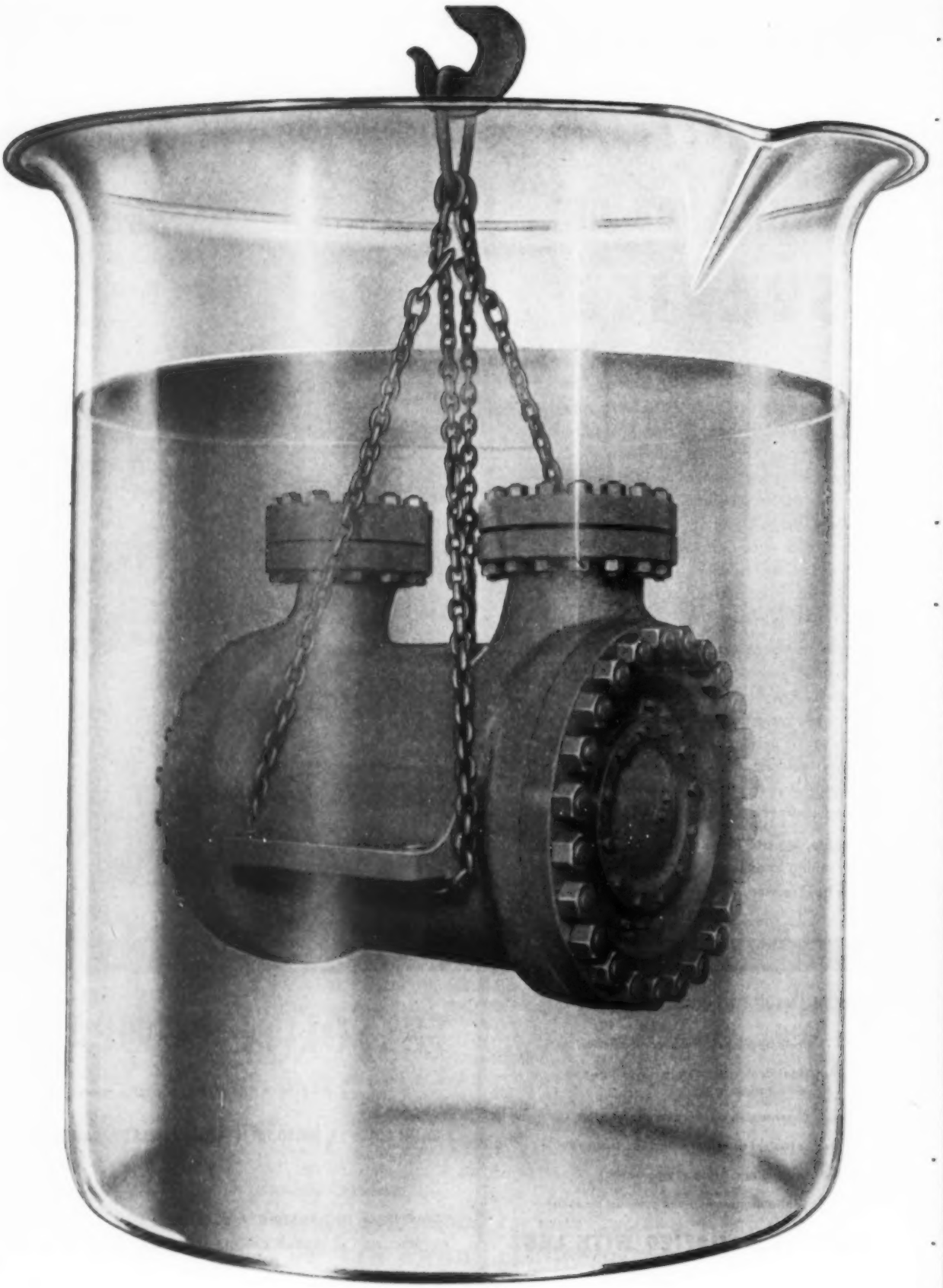
TRETOLITE COMPANY

A DIVISION OF THE PETROLITE CORPORATION

SAINT LOUIS 19, MISSOURI • LOS ANGELES 22, CALIFORNIA

Chemicals and Services for the Petroleum Industry

DESALTING • DEHYDRATING • CORROSION INHIBITING • SCALE PREVENTING • WATER DE-OILING • PARAFFIN REMOVING



"DUNKED"
for your protection

Until a few years ago, if anyone had even *suggested* the use of a centrifugal compressor for over 1000 psi, the idea would have been considered absurd.

Today, pressures of not only 1000 psi, but in excess of *3000 psi*, can be safely handled by the new Clark "Barrel Type" Multi-Stage Centrifugal Compressor.

To assure complete safety to the operators, the cases of these units are hydrostatically tested by Clark at 1½ times maximum working pressure. As a final test, to detect any possible leakage when handling such hazardous gases as hydrogen, the units are pressurized with hydrogen in excess of maximum working pressure while submerged in water . . . *"Dunked" for your protection.*

Already refinery-proved, Clark "Barrel Type" Centrifugals are scheduled to be installed, in the near future, in 7 new catalytic reforming plants which will have a combined capacity of 100,000 barrels per day. They are equally well suited to many other high pressure applications, such as repressuring, ammonia synthesis and wind tunnels.

Your nearest Clark representative will give you complete details.

CLARK BROS. CO. • OLEAN, N. Y.

DIVISION OF DRESSER OPERATIONS, INC.

SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

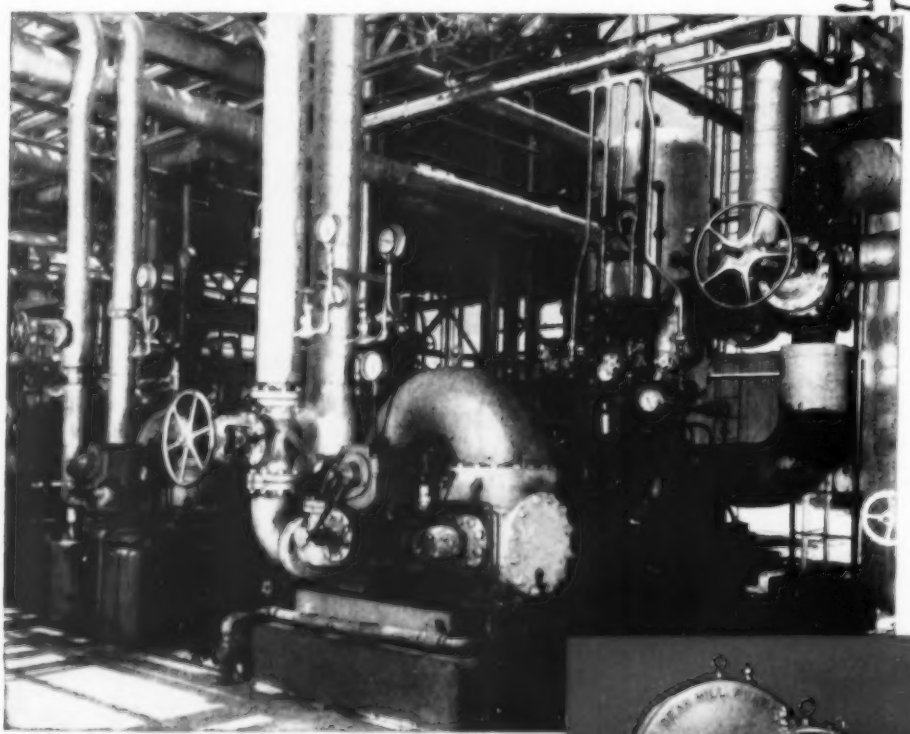
CLARK compressors

Clark continues to set the pace in compressor progress

© 1953, Clark Bros. Co., Division of Dresser Operations, Inc.

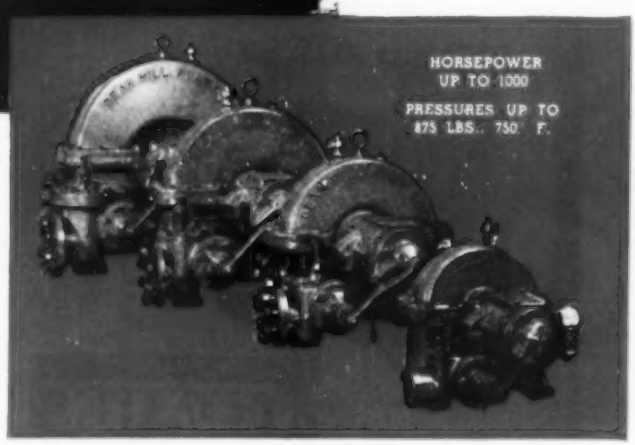
How to stretch a "Power Penny"

You'll never know how much power a penny will buy until you get Dean Hill Steam Turbines on the job. Their super rugged construction, their service-engineered design, their low maintenance, their remarkable power-producing ability all add up to more power per penny.



POWER AT WORK

Here are Dean Hill Type DH Steam Turbines at work driving centrifugal pumps at Bay Petroleum Corporation's Chalmette, La. refining operation.



DEAN HILL TURBINES are specifically designed for operation at medium steam pressures. Since they are the single stage, double impact type, low steam consumption is a tremendous economy feature. Steam rates are excellent under these conditions. Get full details and specifications. Write today.

DEAN HILL PUMP COMPANY

Pump and Turbine Engineers Since 1895

INDIANAPOLIS 7, INDIANA

Chicago • New York • San Francisco • Boston • Denver • Albuquerque • El Paso • Salt Lake City • New Orleans • Philadelphia • Tulsa • Los Angeles • Pittsburgh • Houston • Dallas St. Paul • Toledo • Cleveland • Grand Rapids • Birmingham, Ala. • Louisville • Memphis • Nashville • Richmond • Bogota, Col. • Mexico City • Montreal • Reading, Pa. • The Hague, Neth-

3 quality chemicals for superior Gas Scrubbing

Jefferson

monoethanolamine
diethanolamine
diethylene glycol

for sweetening natural and refinery gas

for dehydrating natural gas

Jefferson monoethanolamine, diethanolamine and diethylene glycol are produced at Jefferson's modern plant at Port Neches, Texas, and shipped from conveniently located distribution points at Port Neches, Houston, Chicago and Tenafly, New Jersey.
All three of these highest-quality chemicals are available for immediate delivery—in tank cars, tank wagons or 55 gallon drums. Our technical service staff will be glad to help you with any problems concerning their application. Write or call your nearest Jefferson representative.

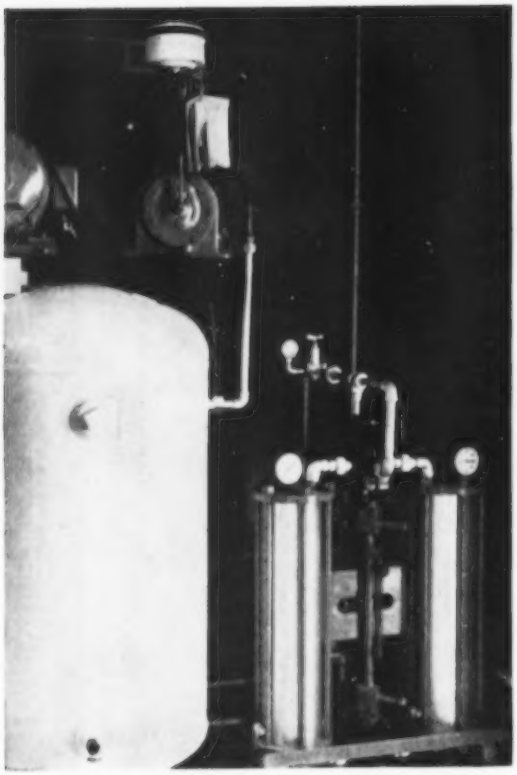
Specialists in *essential chemicals from hydrocarbon sources*

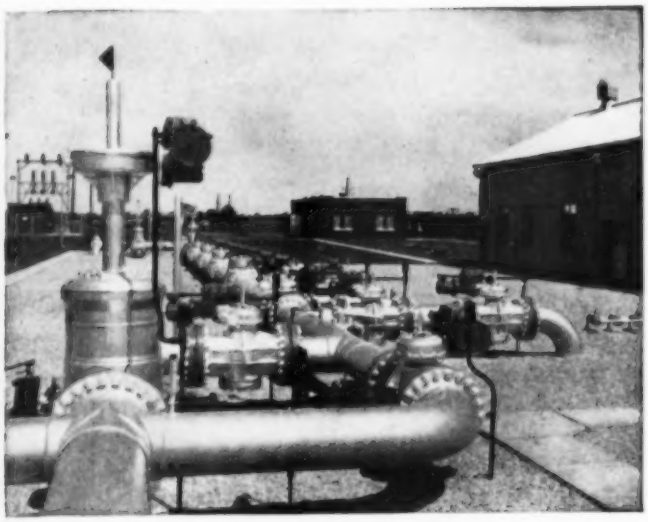
Jefferson
CHEMICAL COMPANY, INC.

260 Madison Avenue, New York 16, N. Y.

Branch Sales Offices: 180 West Washington St., Chicago 2, Illinois; 318 Melrose Building, Houston 2, Texas
Sales Agent: Nelson A. Howard, Jr., 900 Wilshire Boulevard, Los Angeles 17, Calif.
Warehouse Stores: Tenafly, New Jersey; Chicago, Illinois; Houston, Texas

Ethylene Oxide
Ethylene Glycol
Ethylene Dichloride
Diethylene Glycol
Monoethanolamine
Diethanolamine
Triethanolamine
Nonyl Phenol
Morpholine
Ethylene Carbonate
Propylene Carbonate
Diethylethanolamine
Hydroxyethyl Morpholine





This Lectrodryer, tiny but dependable, dries the air as it goes into the receiver. Automatic instruments feed it to lines controlling pumps in the building to the right and to valves on this pipeline distribution manifold.

LECTRODRYERS* keep moisture from choking automatic controls

Air-actuated instruments trigger valves, start pumps and keep traffic-control-indicators alive at this Platte Pipeline pumping station, Salisbury, Missouri. Moisture in the instrument air can kill this entire automatic operation.

That's why these pumping stations are equipped with Lectrodryers . . . to do away with the moisture that might choke air lines and controls with ice, rust, scale and sludge. Air from the compressors first passes through a Lectrodryer. And, no matter how high the humidity is out-of-doors, no moisture gets past this dryer into the lines.

Elsewhere in Industry, Lectrodryers are DRYing air, gases and organic liquids; preventing contamination of products, helping to hold delicate reactions on the beam and speeding up production. Standard models, proved in many years of service, are available . . . to handle small or tremendous volumes, pressures up to 6,000 psi, dewpoints below −110° F.

The booklet, "Because Moisture Isn't Pink", describes many of these installations. Write for a copy, or tell your troubles with moisture to Pittsburgh Lectrodryer Corporation, 307 32nd Street, Pittsburgh 30, Pa.

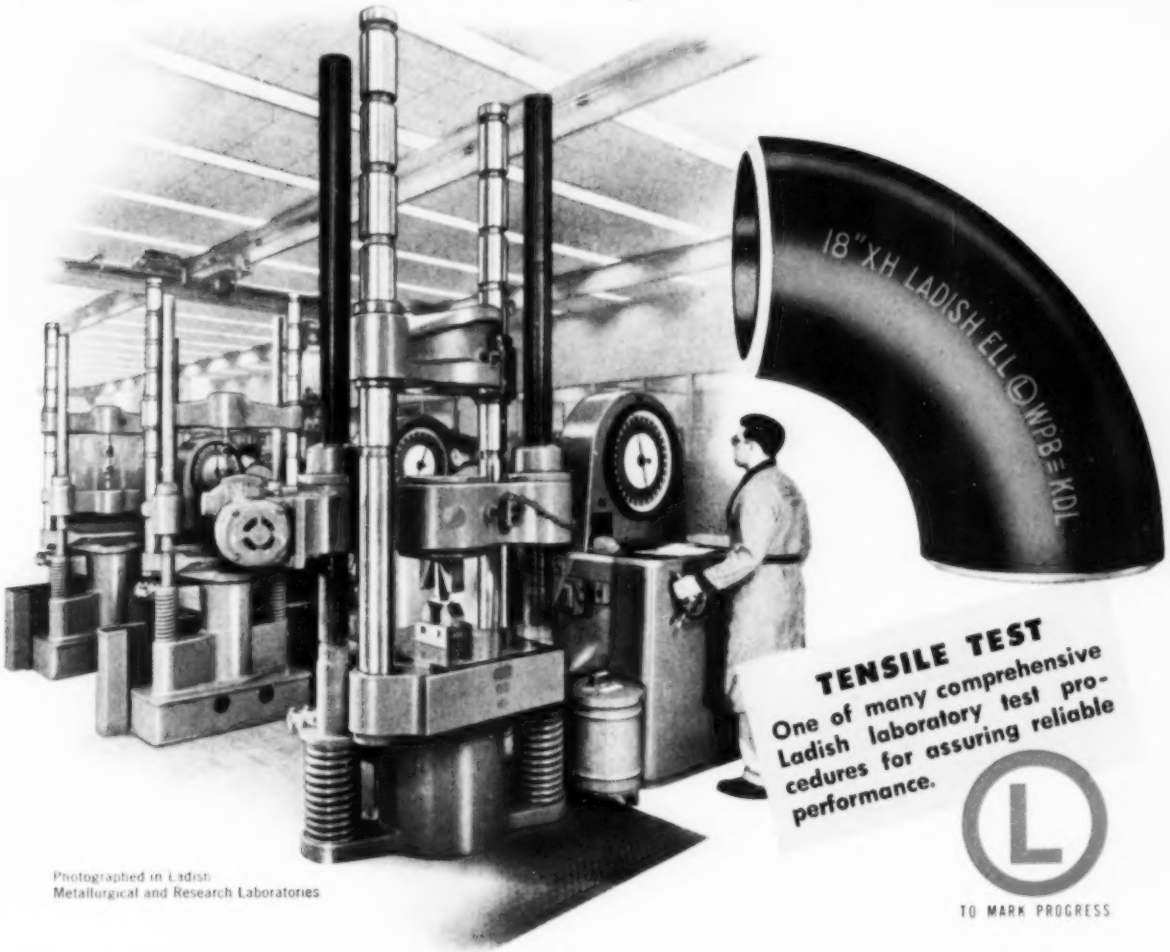
In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U.S. PAT. OFF.

LADISH *Controlled Quality* ASSURES METALLURGICAL SOUNDNESS



Photographed in Ladish
Metallurgical and Research Laboratories

TENSILE TEST
One of many comprehensive Ladish laboratory test procedures for assuring reliable performance.

TO MARK PROGRESS

Testing the breaking point of metal... proves Ladish fittings have ample strength to meet the test of maximum service

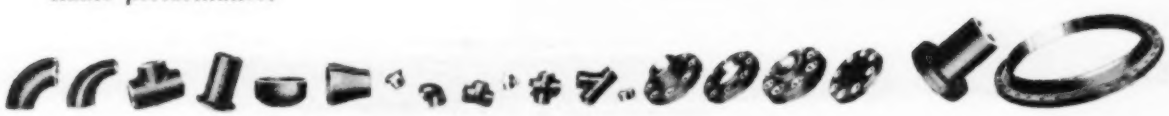
Optimum strength — proved by scientific test — typifies the outstanding values in Ladish fittings that result from special emphasis on sound metallurgy and advanced facilities. Shown here is modern Universal tensile testing equipment on which ultimate strength, yield strength, reduction of area and elastic properties are carefully measured to assure users of Ladish Controlled Quality fittings the metal quality essential for reliable performance.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF... ONE RESPONSIBILITY

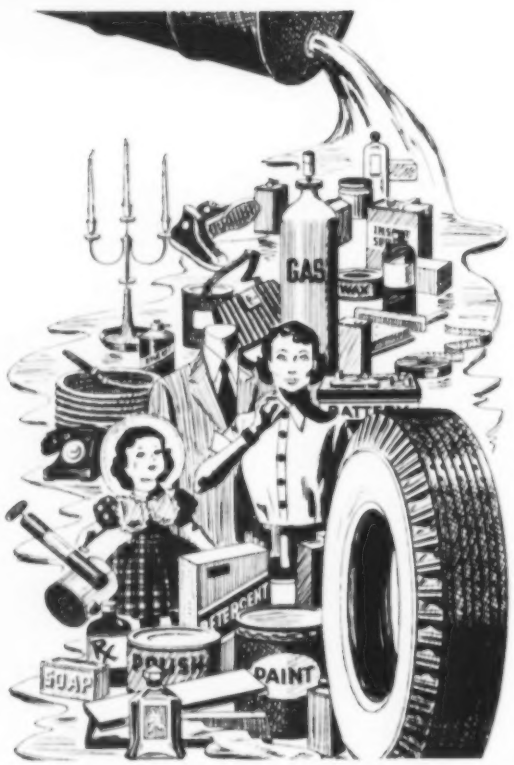
LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.



To the Weaver, the Baker, the Beauty Maker

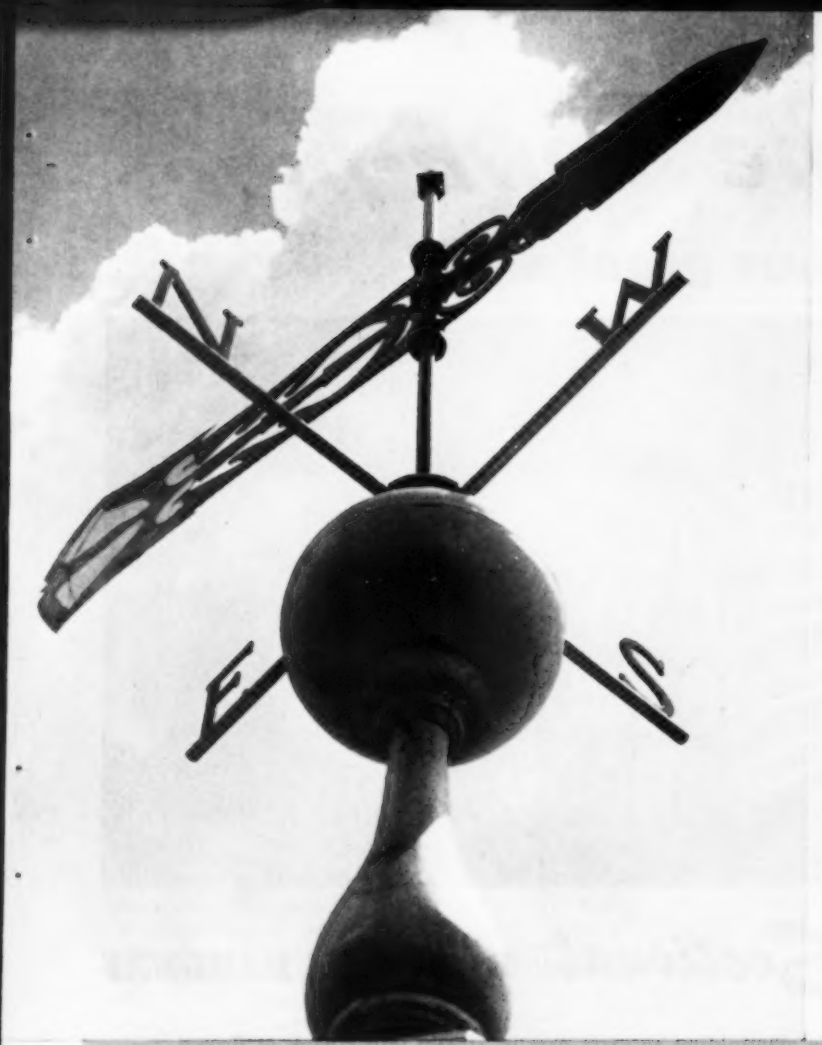


Rub-A-Dub-Dub, want a suit you can scrub, face cream, or a well-protected loaf? Then we can help you, for Standard Oil Company of California has put oil to work for the weaver, the baker, the beauty aid maker—and practically everyone else. In addition to supplying 88% of the 7 Western states' energy, oil men have a hand in providing you with thousands of other things you *don't* buy in a service station. Suits, for instance! That wrinkle-resistant model you may be wearing was woven from an oil-born ingredient developed in our research laboratories. Bread, too! Millions of loaves were wrapped last year in paper coated with Standard wax. Whenever you light a candle, polish a shoe, or empty a milk carton, you may be using wax turned out by Standard Oilers. And when your wife creams her face we're involved, too. Each year we supply ½ million gallons of highly-refined oils to cosmetic makers—enough for 10 million jars of face cream. These examples of oil's place in modern living emphasize one important point: The oil industry has moved from kerosene to synthetic fabrics in one short generation—and so have you. Oil progress is *your* progress.

What comes from a drum of oil? Auto tires, medicines, nylons, detergents, plastics, paints, insecticides, cleaning fluids—and thousands of other products. And that's because oil companies like Standard invest millions each year to find new ways to make oil serve you better. *Your questions or comments about our Company or industry are always welcome. Write: Standard Oil Company of California, P. O. Box 3495-E, San Francisco, California.*

STANDARD OIL COMPANY OF CALIFORNIA

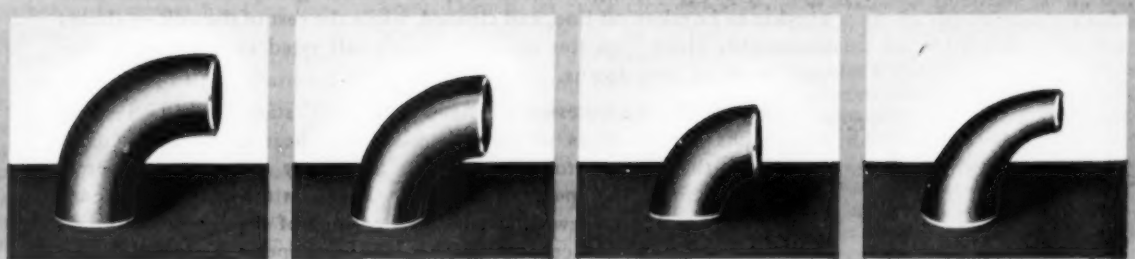
plans ahead to serve you better



A Four-Way Selection

This photograph of a weather vane seems a good way to point out the fact that there are four different types of Midwest Welding Elbows (see below). These are more types than are manufactured by any other company. This greater selection is important to users of welded piping because it gives the engineer greater latitude in piping design and permits improvements and economies not otherwise possible in welded piping systems. For more information on this subject, ask for Catalog 48.

MIDWEST PIPING COMPANY, INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices:
New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.
STOCKING DISTRIBUTORS IN PRINCIPAL CITIES



MIDWEST "LONG TANGENT"
Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".

ASA STANDARD
Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings. ASA B16.9. Tolerances much less than allowable. Sizes to 28".

SHORT RADIUS
Recommended where space is limited. Sizes to 30". Also available with "Long Tangents" in sizes 14" to 30".

MIDWEST REDUCING
Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.

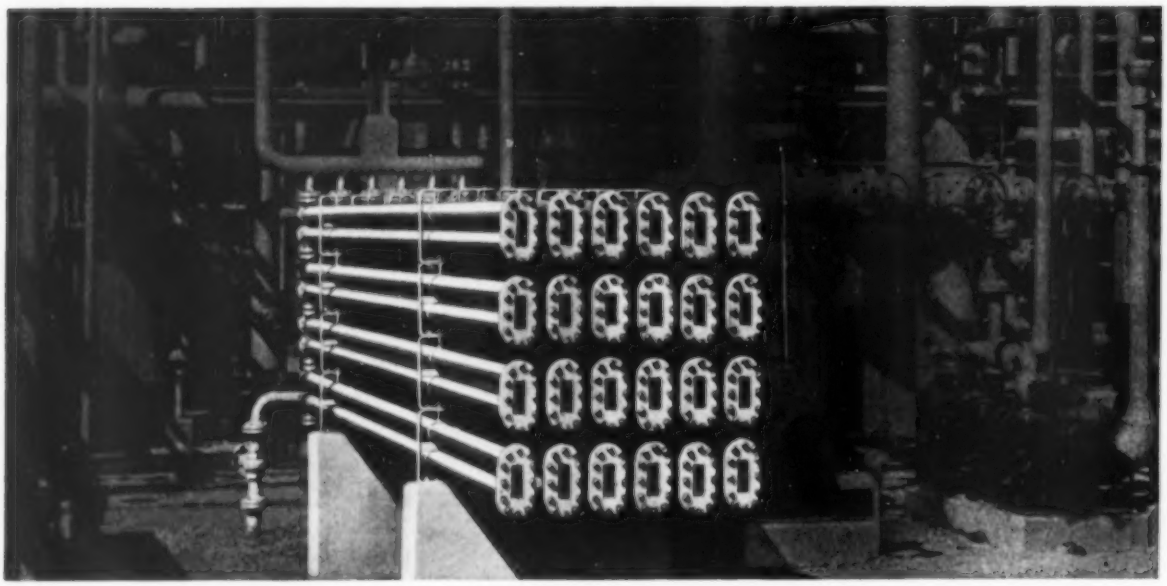
MIDWEST WELDING FITTINGS

IMPROVE PIPING DESIGN AND REDUCE COSTS

6109

Eliminate Down-Time

in your plant with



BROWN FINTUBE *Sectional* HEAT EXCHANGERS

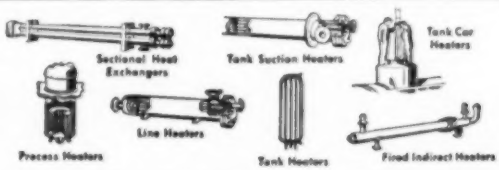
● Simply manifolding an extra parallel stream into a bank of Brown Fintube Heat Exchanger **Sections,** permits one group of sections after another to be taken off-line, and cleaned, while the rest of the unit — always thoroughly clean — carries the exchanger's full rated capacity, year after year, without shut-downs.

This avoids the necessity of carrying a 100% standby unit, to assure continuous operation, as when a "bundle" type heat exchanger is used. It permits the sections to be cleaned as frequently as the duty requires without affecting other parts of the plant. It avoids the loss in efficiency that results from just a few thousandths of an inch of deposit on the tubes; and assures clean surfaces and highly efficient operation at all times.

Eliminating down-time is only one of Brown Fintube's many advantages. Flexibility to meet changing plant requirements; reduced fouling; and prompt delivery are some of the others. Bulletin No. 512 contains full details; and will give you many proven, money-saving ideas! *Send for a copy.*

BROWN FINTUBE
HEAT TRANSFER PRODUCTS

BROWN FINTUBE CO.
Elyria, Ohio



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MEMPHIS • BIRMINGHAM • NEW ORLEANS • SHREVEPORT • TULSA • HOUSTON • DALLAS • DENVER • LOS ANGELES • SAN FRANCISCO • and ST. THOMAS, ONT.

FOAM FACTS

Published quarterly in the interests of fire protection everywhere.

NATIONAL FOAM SYSTEM, INC.

WEST CHESTER, PENNA.

Quality Control in Every Step Assures Safe, Fire Blanketing Foam

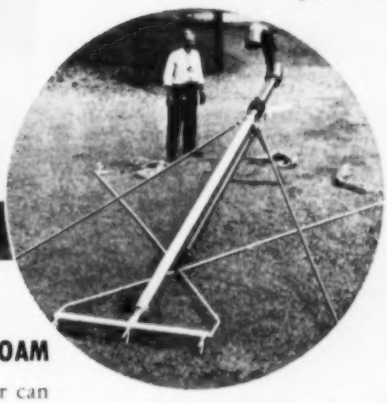
There's a difference in foam. Not all foam is good foam for the extinguishment of flammable liquid fires. Bubble size and stability are important and photomicrographs disclose major variations in foams of differing manufacture.

A rigid system of "quality control" in every step of manufacturing assures the right foam in National Aer-O-Foam. Photomicrographs of National Aer-O-Foam show a mass of uniformly small bubbles tightly knit in an unbroken blanket of fire-smothering foam that has long lasting stability.

There is a reason for this consistent, dependable quality. National Foam System controls every step of the manufacture of its foam in its own plants. Every one of the more than a dozen chemicals are pre-tested for peak quality and re-tested during processing. Finished products are then Fire-Tested for actual performance. When you buy National Aer-O-Foam you are certain of quality and Fire-Tested Protection.

NEW FOAM TOWER SAVES MANPOWER, SPEEDS TANK PROTECTION

Compact, needs Only Four Men To Operate



A new portable foam tower raised and lowered by hydraulic action is now available. It can be set up in a fraction of the time formerly needed and with one-third the manpower. The same tower may be used for tanks of different heights and can easily be converted for use with chemical foam.

Quick dependable hydraulic action, which can be applied at a safe distance from the fire, raises the tower to full height in a matter of seconds. When it is elevated to a point above the upper edge of the tank wall, pressure is released and the tower gradually descends until the gooseneck is hooked over the edge of the wall. All of this is achieved hydraulically with a minimum of manpower and with less pressure than necessary for the foam system itself. Each tower is equipped with National Foam's exclusive Selective Orifice Foam Maker. Write for new data sheet 653-3-A.

QUICK CHANGE UNIT PROPORTIONS DRENCH OR FOAM

A new National Proportioner can be used either for Aer-O-Foam Liquid or National's penetrating wetting-agent, Drench. Its quick changeover feature allows fire to be brought under control with a blanket of foam and the surrounding area to be wet down to contain the fire.

The prolonged dry spells of this summer have given fire fighters the opportunity to learn about the quick effectiveness of Drench. Used as a wetting agent on Class A fires, a 1% Drench solution effects a 40% to 70% reduction in both the extinguishing time and the amount of water used.

By simple valve adjustment either Drench or Aer-O-Foam can be quickly proportioned in this new National Proportioner.

Get Your Copy of FOAM FACTS

For interesting facts and data on fire protection let us mail you FOAM FACTS Quarterly. Send in your request.

Varying Water Conditions?

Acid Action?

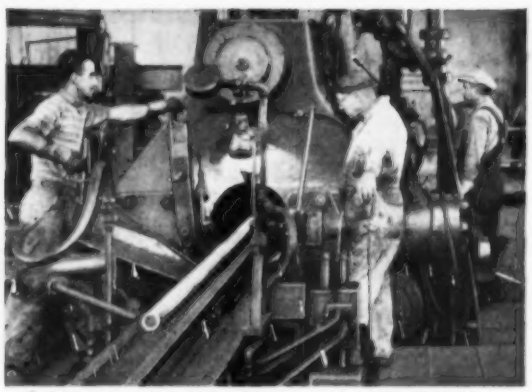
Varying Temperatures?

FACING TUBE

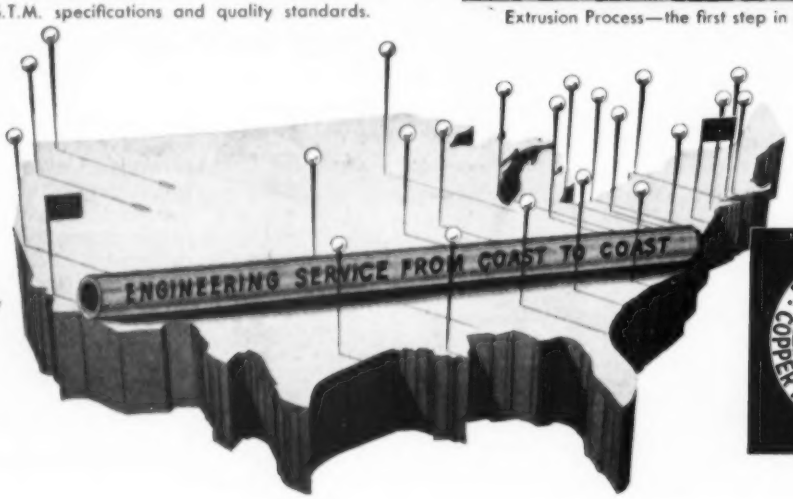
Heat Coolers...

PUT PHELPS DODGE

Tubes are hydrostatically tested and inspected to meet latest A.S.T.M. specifications and quality standards.



Extrusion Process—the first step in producing tubes.

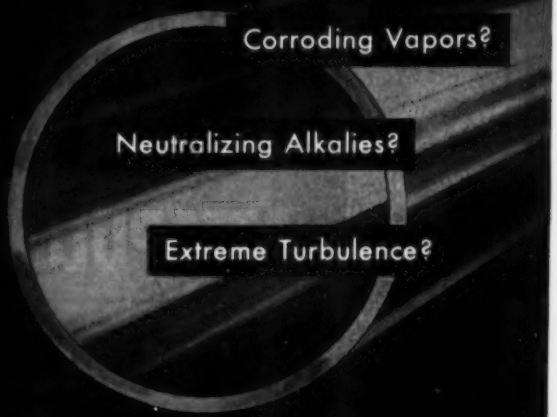


TUBE MILLS IN:
Los Angeles, Calif.
Bayway, New Jersey

DISTRICT OFFICES
at key points

PHELPS DODGE COPPER PRODUCTS CORPORATION
MINE TO MARKET
P D

PROBLEMS IN *Exchangers... Evaporators?*



"KNOW-HOW" TO WORK!

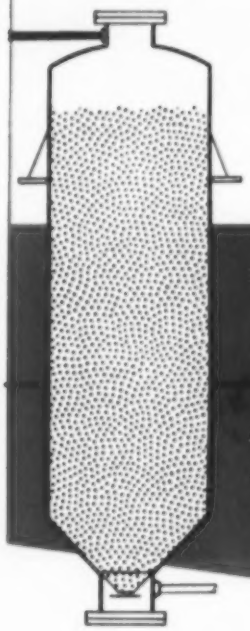
- *Specialists in tubes for heat exchangers, coolers and evaporators,* with years of experience in solving tough tube-operating problems.
- *Pioneers* in "trouble-shooting" service. Research personnel and facilities second to none.
- *Highest quality*—assured by Phelps Dodge Hot-Forged, Extrusion Process and exacting mill control through every step of tube manufacture.

Phelps Dodge Heat Exchanger Tubes are available in following alloy combinations:

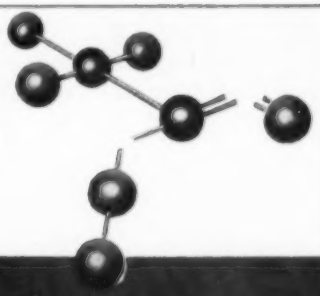
Admiralty (plain or inhibited)	Cupro-Nickel, 30%
Admiralty (Blackskin)	Cupro-Nickel, 20%
Aluminum Brass	Cupro-Nickel, 10%
Aluminum Bronze	Superloy
Red Brass	Copper (Deoxidized and Arsenical)

PHELPS DODGE COPPER PRODUCTS CORPORATION

40 WALL STREET, NEW YORK 5, N. Y.



...ready to tackle
any sorptive-mineral job
that comes along...



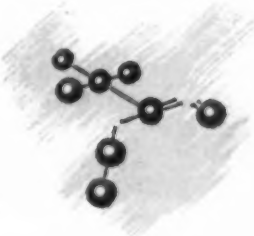
ATTAPULGUS Fullers Earth
POROCEL Activated Bauxites

ADSORBENTS

There's an Attapulgus or Porocel adsorbent to fit your process technique for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from process liquids or gases. Materials treated in principal applications are: motor oils and other lubricating, specialty, and technical oils; petrolatums and waxes; aviation and motor gasoline stocks; kerosene; diesel and heating oils; chemicals and petrochemicals.

CATALYSTS, CATALYST CARRIERS

Our sorptive minerals are recognized standards in desulfurization, reforming and isomerization systems—catalytic removal of unsaturates—conversion of sulfides to elemental sulfur—fluid catalyst applications—as catalyst carrier in copper sweetening processes.



DESICCANTS

We offer a wide range of reliable, thoroughly proved desiccants for drying air, hydrogen, carbon dioxide, hydrocarbon liquids and gases.

SPECIAL GRADES

Mine and plant facilities permit prompt and economical production of grades meeting individual customer specifications. Our laboratories and technical staffs are ready to assist in research, development, design and operating problems. Your inquiries are invited.

ATTAPULGUS MINERALS & CHEMICALS CORPORATION · **POROCEL** CORPORATION

Dept. W, 210 West Washington Square, Philadelphia 5, Pa.

Acid for Uranium

from Chemico-Built Plants

The leaching of uranium ores requires substantial quantities of sulfuric acid. To help meet this need, Chemico designed and supplied this plant in South Africa for an important producer of uranium. It is the first of five Chemico plants which are now operating or nearing completion in South Africa alone for this purpose.

Designed and delivered on a rush schedule, this plant went into smooth and full operation promptly on completion and is running consistently above rated capacity.

Chemico's service goes with its plants wherever they are installed. Even at this distant location, skilled Chemico engineers supervised the construction and initial operation of the plant and trained the operators until they were thoroughly familiar with its working.

Here is another example of Chemico's widespread activities, constantly enlarging the scope of its experience.

We welcome your inquiries on any heavy chemical production problem. No obligation, of course.

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

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TECHNICAL REPRESENTATIVES: CYANAMID PRODUCTS LTD., LONDON • CHEMICAL CONSTRUCTION (INTER-AMERICAN) LTD., TORONTO • SOUTH AFRICAN CYANAMID (PTY) LTD., JOHANNESBURG

CHEMICO CHEMICAL CONSTRUCTION

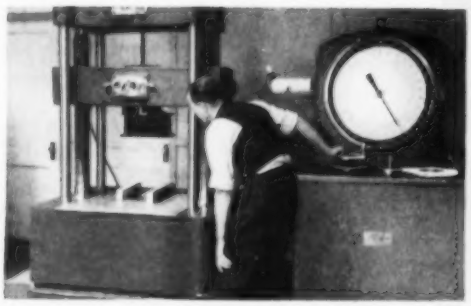
Chemico plants are profitable investments

CC 358

Why Grinnell is America's #1 Supplier of PIPE HANGERS *and* SUPPORTS

GRINNELL, ALONE, MANUFACTURES A FULL LINE OF HANGERS AND SUPPORTS

No other company, anywhere, makes a line as complete or varied. Grinnell produces hangers in thousands of combinations to support any piping.



GRINNELL, ALONE, MAINTAINS AN EXPERIENCED LABORATORY STAFF OF TRAINED TECHNICIANS

In its modern, well-equipped laboratory, tests are constantly being made to discover better ways of solving old and new pipe suspension problems.

Grinnell makes scientifically designed, ruggedly built pipe hangers and supports for every type installation.

GRINNELL, ALONE, PROVIDES ENGINEERING ASSISTANCE IN DESIGN AND INSTALLATION

Grinnell makes available specialized knowledge in the computation of hanger loads and the selection of the correct supports. Engineers in the field assist with problems in erection of pipe hangers.

GRINNELL, ALONE, THROUGH ITS CONVENIENT WAREHOUSES CAN SUPPLY YOU "OUT OF STOCK"

No manufacturer of pipe hangers offers a distribution system as thorough or efficient. Grinnell warehouses are located in 30 principal cities . . . with jobbers in practically every city, coast to coast.

Pipe suspension presents an extremely wide range of problems involving weights, stress, thermal movement, materials and specialized engineering. No one "goes into" the pipe hanger business overnight. Large manufacturing facilities, skilled technicians, and a lot of down-to-earth practical experience are needed.

Grinnell has become America's No. 1 supplier of pipe hangers and supports only because Grinnell has specialized in piping for one hundred years. Grinnell has developed a line of pipe hangers and supports for every piping requirement, from the simplest to the most complex.

Grinnell is always ready to co-operate with engineers and architects in the preparation of pipe suspension specifications.

Call Grinnell for any and all types of pipe hangers and supports.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Sales Offices and Warehouses in Principal Cities

pipe and tube fittings • welding fittings • engineered pipe hangers and supports
Thermolier unit heaters • valves • Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies • industrial supplies
Grinnell automatic sprinkler fire protection systems • Amco humidification and cooling systems

PROCESS EQUIPMENT NEWS

PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY NOVEMBER 1953

Shop Stream-lined to Raise Capacity

Stream-lining of Kellogg's heat exchanger fabrication facilities is continuing as new equipment is installed in a program aimed at providing production-line manufacture of tubular heat transfer equipment.

As a result of this program, which also includes the rearrangement of existing equipment and layout, Kellogg has been able to accelerate the production of the wide variety of units regularly coming into the shop. For example, a recent order for 200 stainless steel heat exchangers with shells 48 inches inside diameter and tube bundles having 20 foot tubes, was completed in less than 18 months after the order was received.

Cutting Accurate Bevel in Nozzle Hole Essential to Efficient Welding

While there is no unusual skill required in shaping a nozzle hole in an exchanger shell when its outline and location have been clearly indicated by a qualified layout man, it is quite a trick to cut these holes with the proper bevel to produce a perfectly welded joint when the nozzle is attached.

Here, one of Kellogg's highly skilled craftsmen is cutting the inlet nozzle hole in a crude preheater scheduled for installation in a large Gulf Coast refinery. When installed it will exchange heat from a naphtha cut with crude entering a topping still.

The shell, $\frac{7}{8}$ inch thick, has an inside diameter of 27 inches. It will contain a tube bundle having 255 one-inch steel tubes on a $1\frac{1}{4}$" square pitch.

Large Tube Sheet for Chemical Plant Heat Exchanger

When drilling and machining is completed, this large aluminum-killed forged-steel tube sheet will become part of a heat exchanger destined for service in a chemical plant operated by a major U. S. processor.

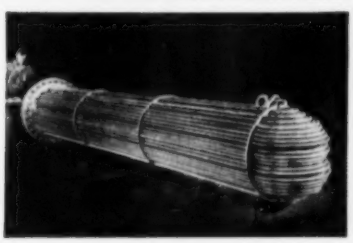
The unit, 60 inches inside diameter and 18 feet long, and containing 5900 sq. ft. of effective tube surface is designed to operate at 8°F on the shell side and 17°F on the tube side.

For further information, details of methods, etc. contact

FABRICATED PRODUCTS DIVISION
THE
M. W. KELLOGG
COMPANY
225 Broadway, New York 7, N. Y.
or offices in Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London & Paris

KELLOGG PULLMAN

Chrome-Moly U-Tube Bundle for Reboiler



This U-tube bundle for a cracked gasoline stabilizer reboiler will soon see service in a small refinery in the Southwest.

The bundle, fabricated from 4-6% Cr, ½% Mo corrosion-resistant steel, is approximately 15 feet in length and will be inserted in a kettle type shell.

The unit is designed for temperatures up to 600°F on the tube side and 400°F on the shell side while processing corrosive materials. Design pressure on both sides is 250 psi.

EXCHANGERS
THIN WALL ALLOY PIPING
CLAD STEEL VESSELS
CONDENSERS
FRACTIONATING TOWERS
PRESSURE PIPING
DIGESTORS
COOLERS

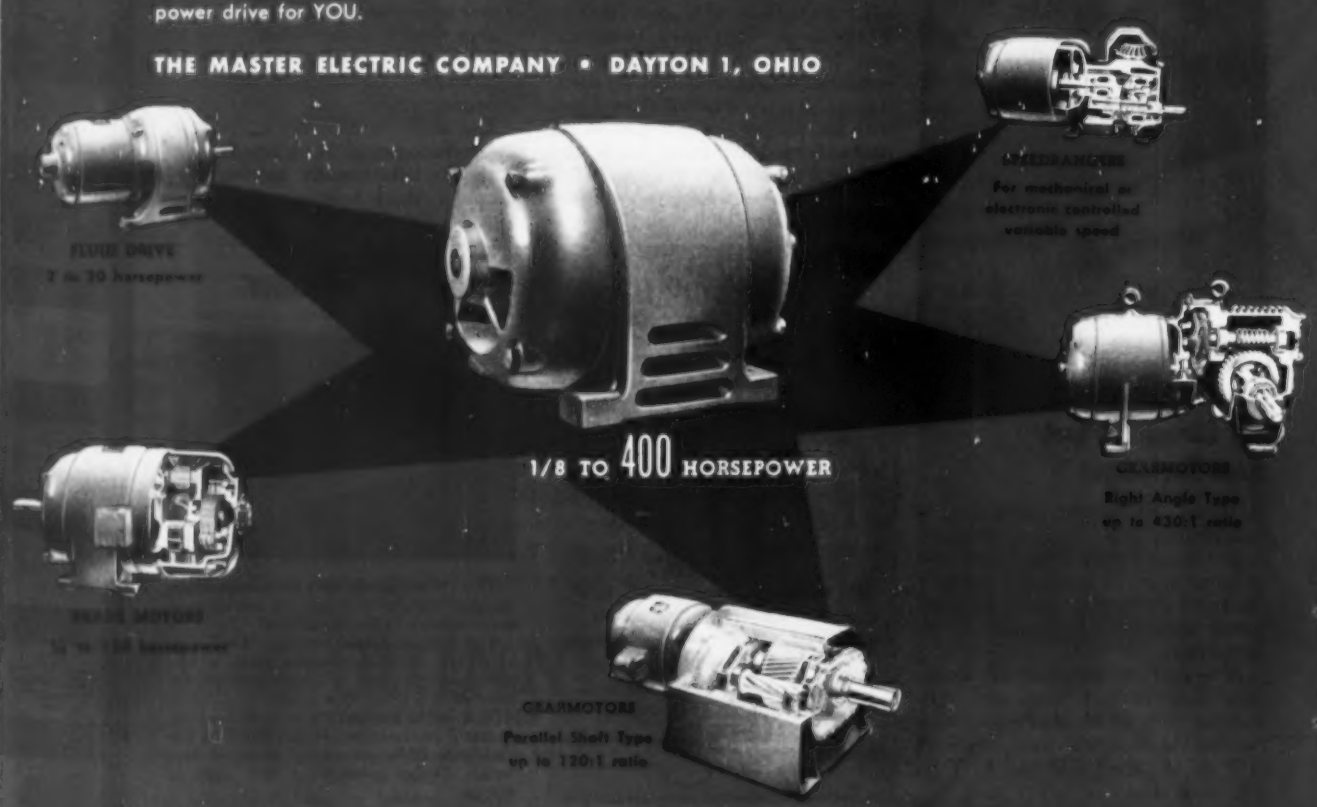
Whenever you select a power unit, don't put a straight-jacket on your ideas . . . consider ALL of the possibilities of modern power drives.

For example consider the many useful combinations that can be secured with the basic Master power units shown below. They're designed so they can be easily combined together to give you the RIGHT horsepower, the RIGHT shaft speed, the RIGHT features in one compact unit that you can use RIGHT where you want it. Nowhere else will you find power units that are so flexible, so easily adaptable, and in such a wide range of types and ratings.

Master power drives are available in thousands and thousands of ratings (⅛ to 400 HP) . . . in open, enclosed, splash proof, fan cooled, explosion proof . . . horizontal or vertical . . . for all phases, voltages and frequencies . . . in single speed, multi-speed and variable speed types . . . with or without flanges or other special features . . . with 5 types of gear reduction up to 430 to 1 ratio . . . with electric brakes . . . with fluid-drive . . . with mechanical or electronic variable speed units . . . and for every type of mounting . . . Master has them all and so can be completely impartial in helping you select the one best power drive for YOU.

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO

give your brains a chance



R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •

Simplified Control and Shut-off of Volume and Pressure

The underground application shows a 50-pound R-S Valve with gear reducer, lubricating lines and operating nut which is hand operated with a wrench. Only a few turns of the wrench are required to open or close the valve.

Practically every R-S Valve installation, particularly when automatically controlled, provides useful experience that can be applied in other industries although they may be far apart in classification. It is this accumulation of engineering experience coupled with unexcelled production facilities that can be so helpful to you.

Call the R-S representative at the inception of your application. Benefit by his research and engineering experience in the simplified control and shut-off of volume and pressure.

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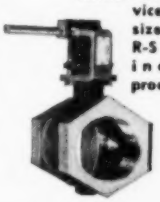
MANUFACTURERS OF HYDRAULIC TURBINES-VALVES

REPRESENTATIVES IN PRINCIPAL CITIES

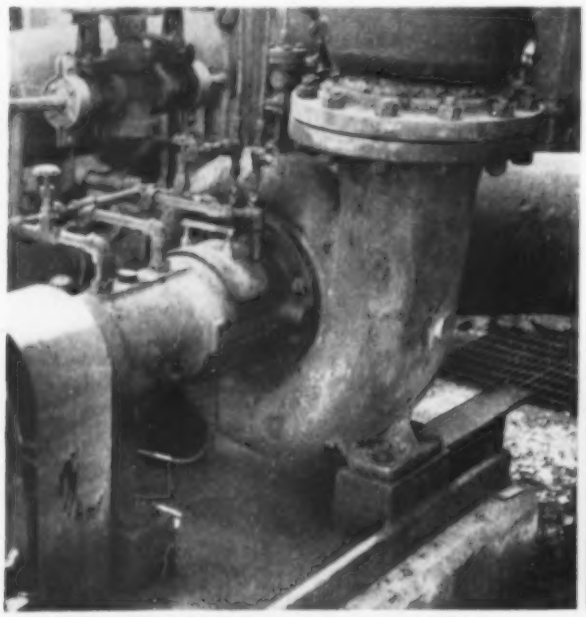
No. 850—Ten-inch, 300-pound valve equipped with 18-8 shafts, hastelloy bushings, stick lubricators and isolating valves, diaphragm top with handjack and positioner. Installed for the flow control of sour crude petroleum.



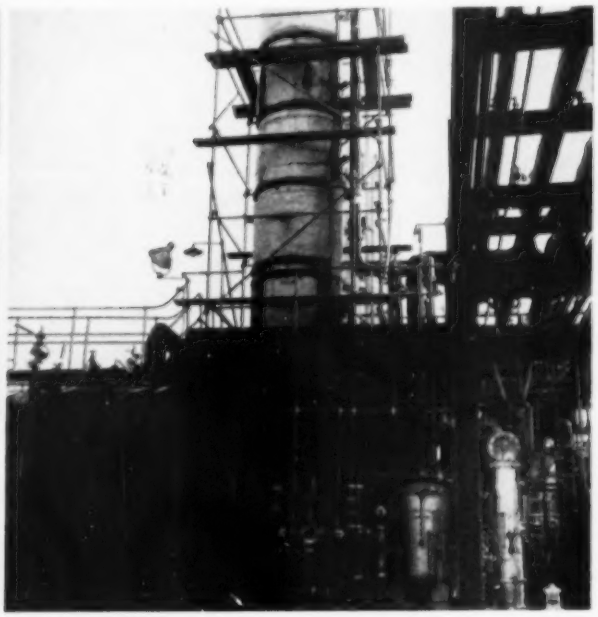
No. 801—Three-inch, 125-pound bronze screwed end valve with handlever control and locking device. There is a size and type of R-S Valve for any industry or process.

Catalog No. 20 describes R-S Valves in detail—types, prime movers, applications and specifications. Contains more than 150 illustrations. Write for your copy.

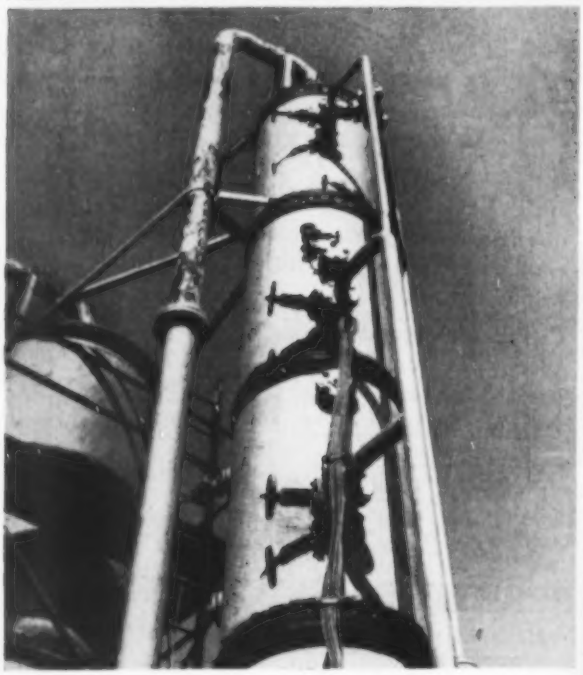
THESE TEN-YEAR-OLD PUMPS for circulating organic acids are built entirely of Stainless Steel. In spite of their long service, they are still in very good condition.



STAINLESS STEEL also resists corrosion in the column and kettle of this batch still kettle for distillation of esters. The equipment, still in good condition, has been in use three years.



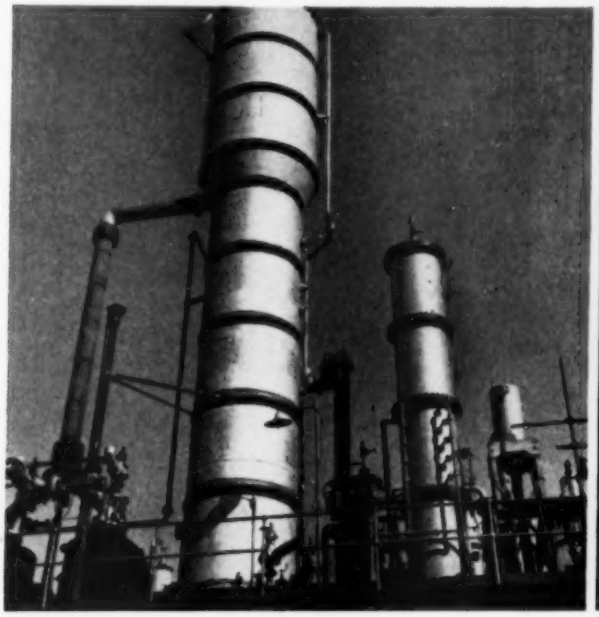
For corrosion resistance



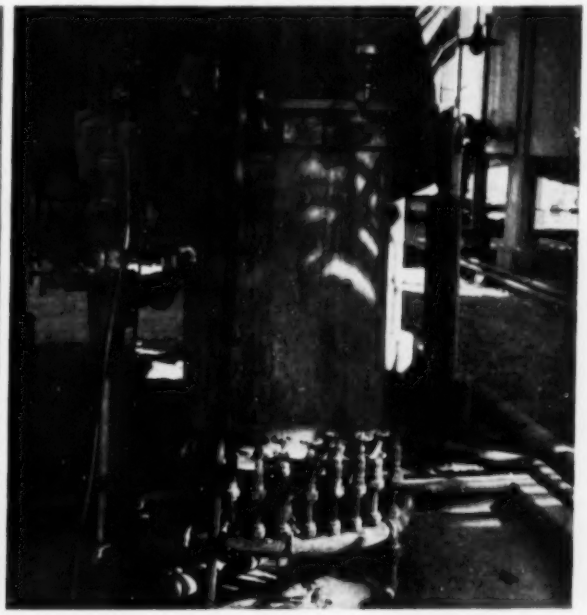
STAINLESS STEEL STRIPPING MILL is used for removing water from organic liquids. It is four years old and still ready for more service.

ALL PARTS of this automatic bagging machine in contact with hot resin are Stainless Steel. Stainless is used to prevent contamination of vinyl resin.

VESSEL AND ALL INTERNALS of this still for distillation of acetic acid are Stainless Steel for resistance to corrosion. The Stainless is in good condition after three to four years' service.



OLIVER LEAF FILTER, used to remove salt from an organic base, has shell, leaves and valves of Stainless Steel. In service between four and five years, it is in excellent condition.



in petro-chemical operations

THIS MAJOR TEXAS PRODUCER SELECTS

STAINLESS STEEL

● At its big Gulf Coast operation, this producer of petro-chemicals makes extensive use of Stainless Steel in many types of processing equipment.

In some of these applications, Stainless Steel's resistance to corrosion led to its selection. In others, the absence of product contamination that Stainless assures was the determining factor.

These are only two of the important benefits of Stainless Steel in chemical processing equipment. Others include ease of cleaning, elimination of downtime for replacement, excellent performance in certain high temperature operations or when high pressures are involved.

It will pay you to investigate the use of Stainless Steel in your plant wherever you need these benefits. And if you want the finest performance, be sure you use perfected, service-tested U·S·S Stainless Steel.

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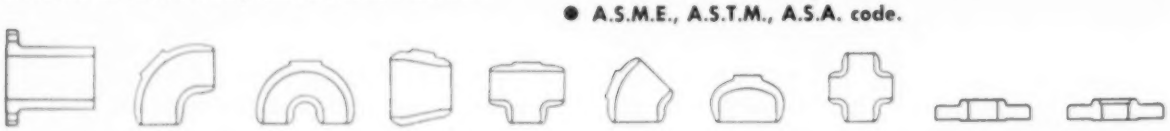

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and facilities for PROCESSING EQUIPMENT

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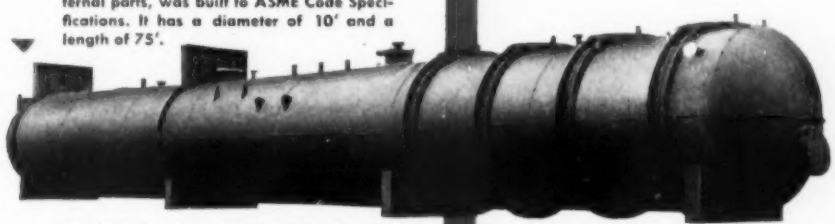
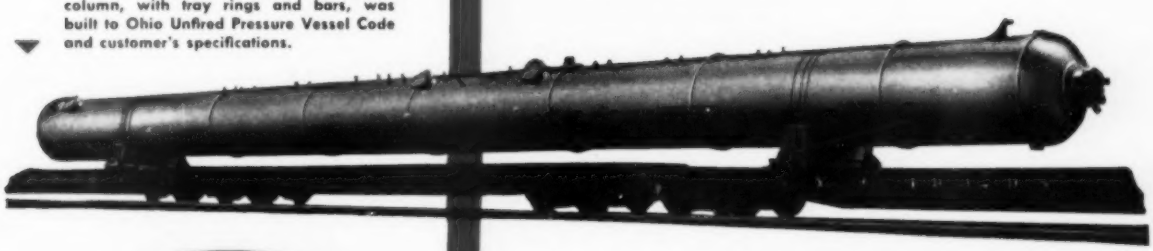
Waste Heat Boiler, complete with inlet and outlet heads. Designed for 275 pounds pressure, 1000° F. maximum temperature at the hot gas end, it is 8' in diameter and has 300-2½" tubes.

This Horizontal Reactor, complete with internal parts, was built to ASME Code Specifications. It has a diameter of 10' and a length of 75'.



This 6'6" diameter x 115' length Isobutane column, with tray rings and bars, was built to Ohio Unfired Pressure Vessel Code and customer's specifications.



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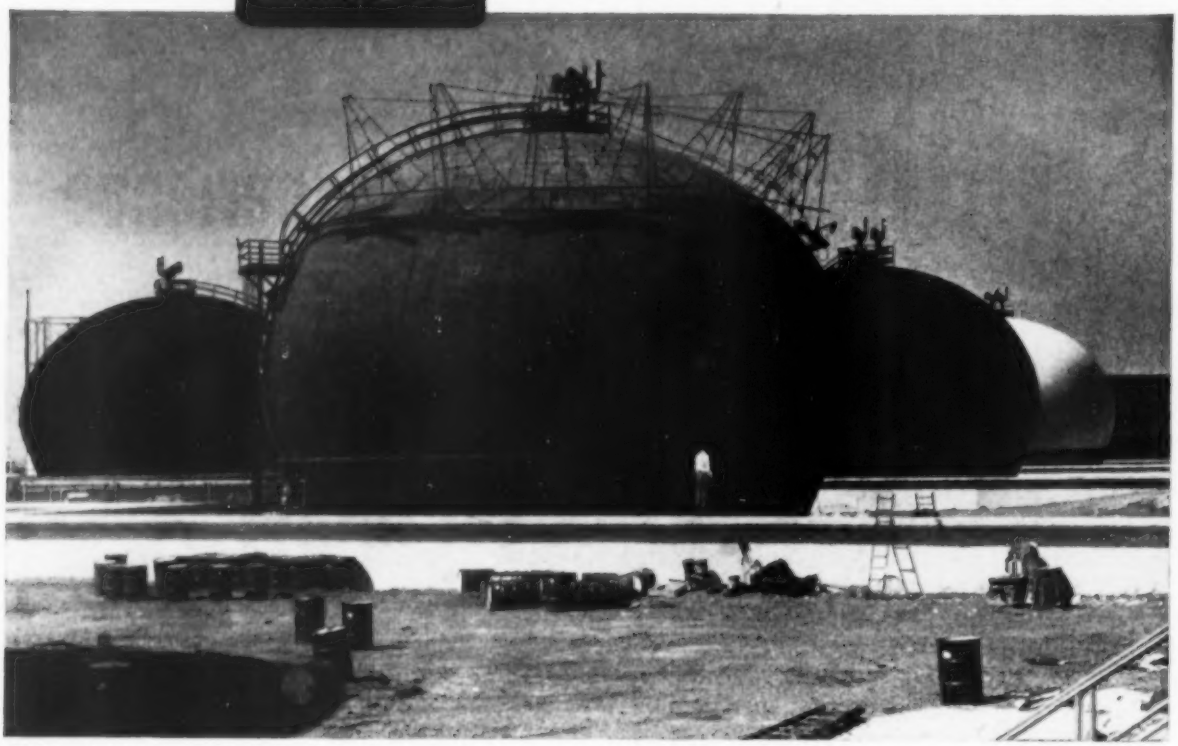

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see our catalog in 5 PLANT ENGINEERING FILE or write for copy

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Refiners throughout the world consult Howe-Baker about emulsion problems. In fact, on 3 continents more than 1,000,000 barrels of crude oil per day are being treated by custom built electrostatic units designed by Howe-Baker. Call us for a detailed discussion of your particular requirements.

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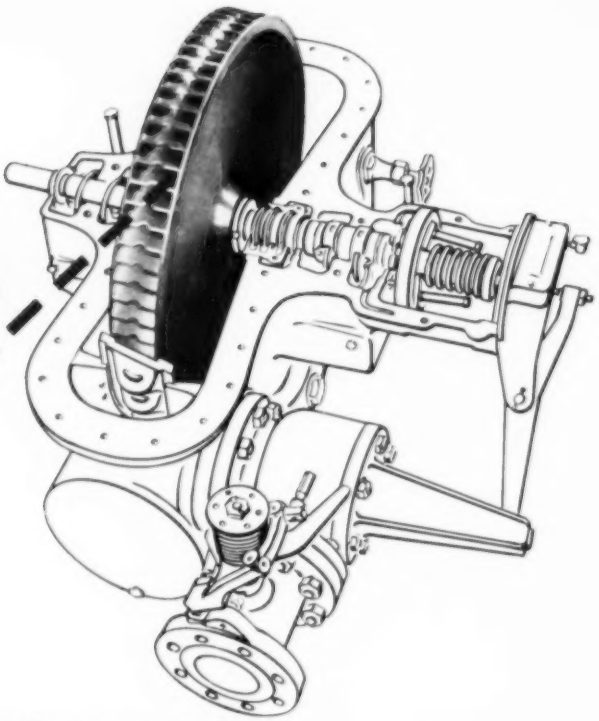

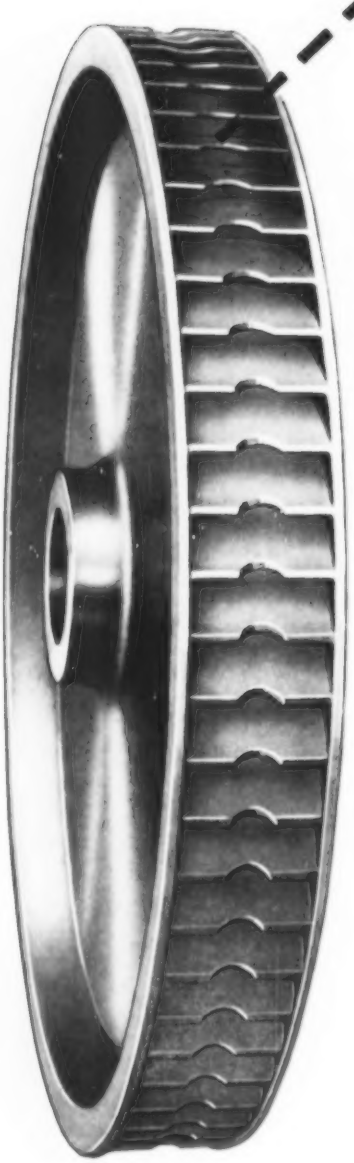

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This is the rotor of a Terry solid-wheel turbine. There are a number of reasons why it has become a symbol for reliable, trouble-free operation.

First, because the wheel is a single forging, in which a series of semi-circular buckets is milled, there are no separate parts to become loose or work out.

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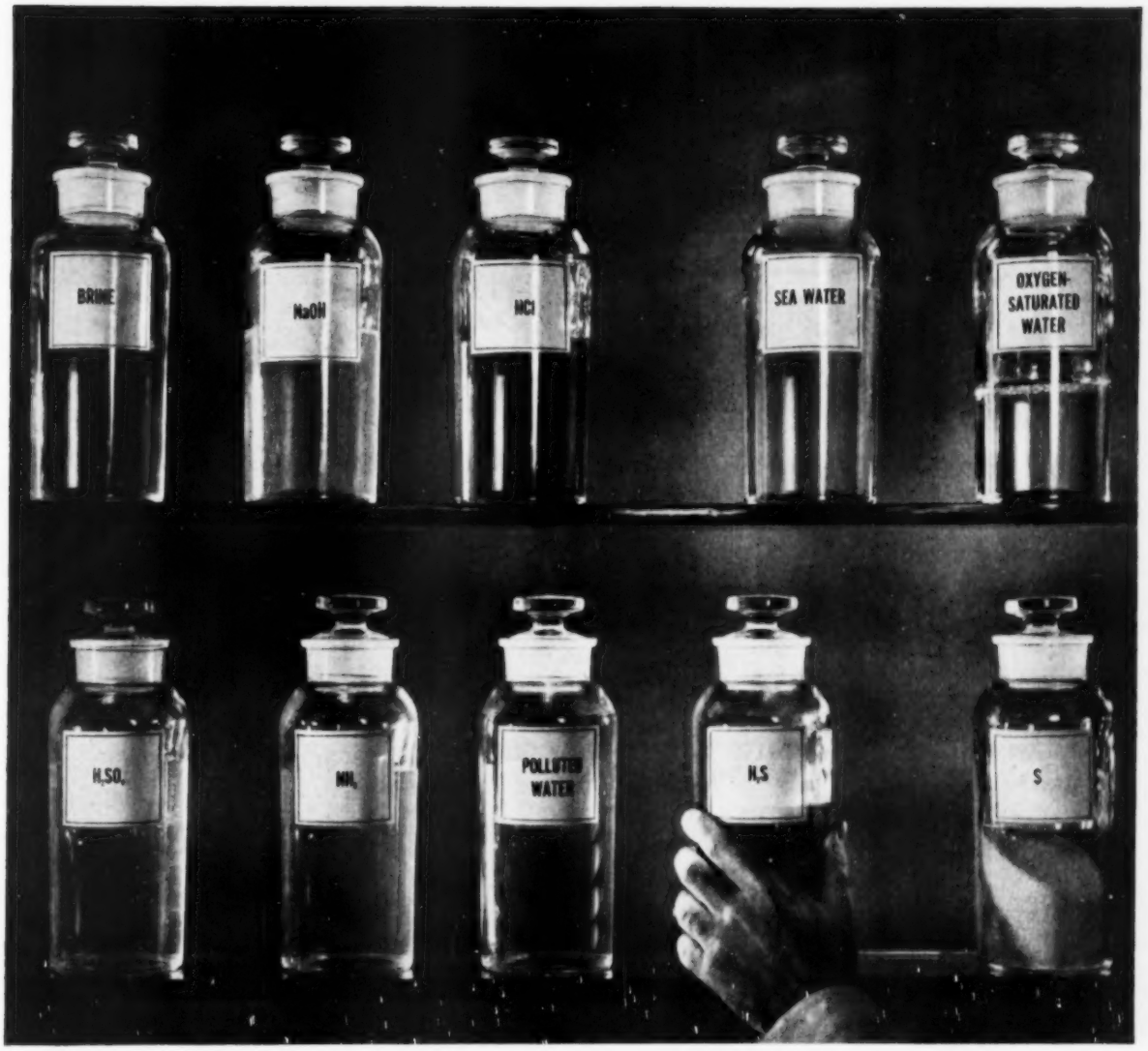

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Experience indicates that there is no one tube alloy that will give better service than all others under all operating conditions. But it is possible to select the material which will give the most efficient and economical service under any specific operating condition.

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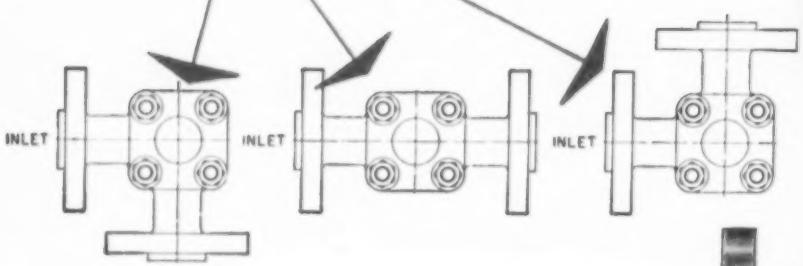

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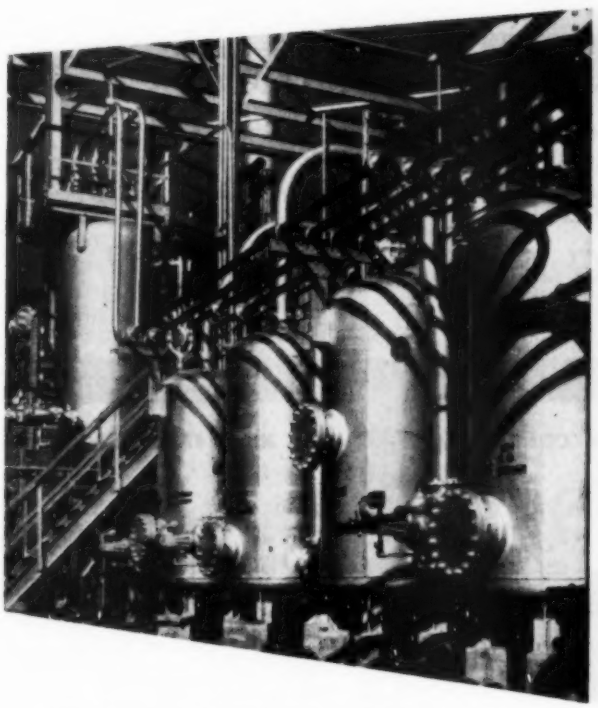

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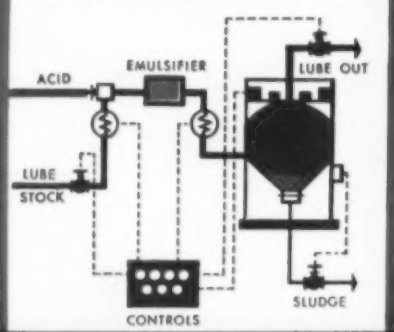
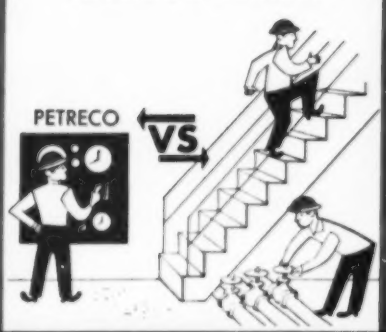
ASSURES BETTER, MORE ECONOMICAL ACID TREATING BECAUSE OF THESE OPERATING ADVANTAGES

CONTINUOUS OPERATION



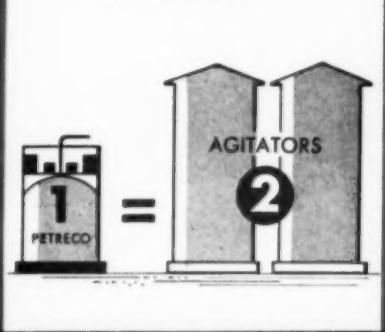
Petreco electric lube oil treating operates continuously, eliminating the many manual operations of old-fashioned batch treating.

AUTOMATIC CONTROL



Automatic controls take time-consuming valve-twirling and stair-climbing out of acid treating. Precision control replaces guesswork.

HIGH EFFICIENCY



The powerful coalescing action of the Petreco electric field insures a fast, clean-break separation of the oil-acid mixture.

PL 53

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PETRECO DIVISION
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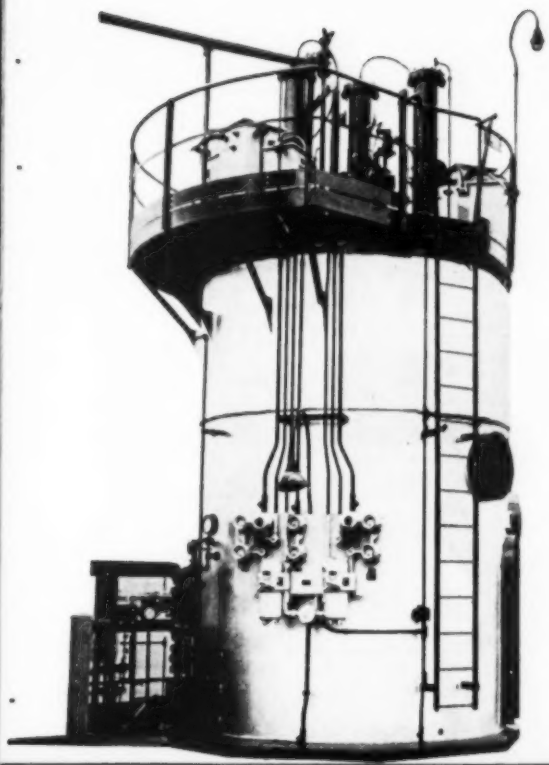
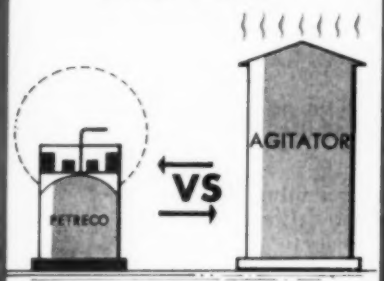


PETRECO ELECTRIC LUBE OIL TREATING applies modern refining practice to the acid treating of lube oils and similar stocks. The stock to be treated is thoroughly mixed with the pre-determined proportion of acid; the resulting mixture is then passed into the Petreco treater. The powerful action of the electric field precipitates the sludge, which is automatically and continuously drawn off. The treated oil passes overhead to the neutralization step.

Petreco treating takes the acid treating of lube stocks out of the manual operation, batch treatment category and puts it in the same class as other modern processes. It provides better, more uniform treating conditions, requires minimum operating attention and insures a rapid pay out.

CLOSED SYSTEM



In the Petreco process, treating is effected in a closed vessel, under pressure. There is no chance for acid spray or fumes to pollute the air.

LOW ACID REQUIREMENTS

The high separating efficiency of the Petreco treater permits the acid and oil to be intimately mixed. Less acid does more work.

IMPROVED PRODUCT

The very brief oil-sludge contact time prevents the continuing reaction of constituents dissolved by the acid, insuring excellent treated product quality.

PETRECO

ELECTRIC PETROLEUM PROCESSING

CRUDE OILS	**Removal of salts, solids, other impurities; dehydrating**
LUBE OILS	**Continuous, automatic acid treating**
DISTILLATES	**Acid treating, caustic treating, doctor treating**
FUEL OILS	**Desaponification, ash removal**

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The **Mail** Box . . .

"Excellent Presentation"

Dear Editor:

"I came back from my vacation and found on my desk the welcomed issues of the PETROLEUM REFINER. I would like to congratulate you again on the excellent way you are presenting information to the public.

"This time I was particularly impressed with the description of the commercial processes as they appeared in the July and September issues. They contain all the information a person needs to understand the mechanism of the processes and their value to the individual refineries. The flow sheets are also excellent. They explain the important steps without blurring the picture with the inconsequential details like heat exchangers and auxiliaries."

V. A. Kalichevsky
Magnolia Petroleum Company
Beaumont, Texas

"A Distinguished Issue"

Dear Editor:

"Thank you very much for the clipped pages of the article by Dr. Ten Eyck and myself in the September PETROLEUM REFINER. I felt that this was one of the most distinguished issues of your journal because of the large number of fine articles therein, and we were of course complimented to be included in such a fine assortment of valuable material as appeared."

Donald F. Othmer
Professor of Chemical Engineering
Polytechnic Institute of Brooklyn

Process Issues Available

Dear Editor:

"The six copies of the September Process Issue arrived here late last week and have been gobbled up. Can you spare 12 additional copies? I would appreciate it very much.

Russell Davis
Air Products, Inc.
Allentown, Pa.

Editors Note: There is a limited number of copies of both the 1953 and the 1952 Process issues for $1 each. Send your request to the reprint editor and please remit with order.

Asks Instrumentation Issue

Dear Editor:

"I would be grateful, if at your earliest possible convenience, you would send me a copy of your manual, 'Instrumentation Handbook' which has received such favorable comment in the petrochemical industry."

William T. Phillips
Petro-Chem Construction
Company, Inc., New York

Red Is the Face!

Dear Editor:

"In re article on Anglo Iranian's new refinery in Western Australia, REFINER, July, 1953, page 93:

"Turning the pictures right side up makes a big difference."

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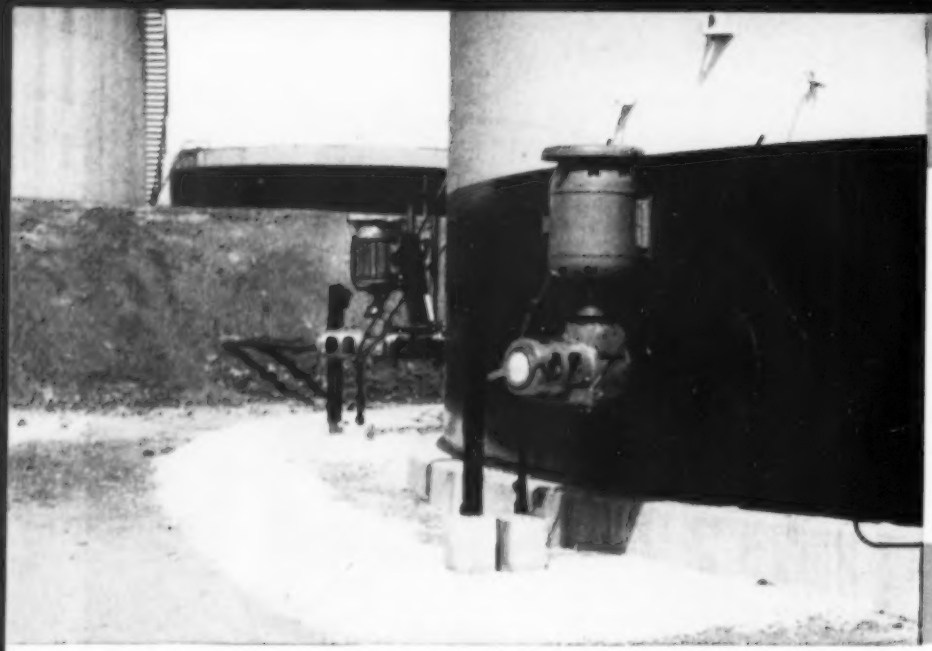

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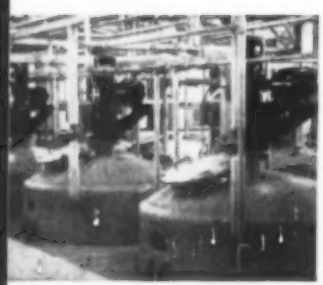
in tanks as large as 150,000 bbls.



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You can save thousands of hours of blending time with LIGHTNIN Mixers.

These units give you up to ten times the volumetric flow possible with other blending methods. That means you save money by reducing HP input, as well as turnover time. And you multiply the productive capacity of your tankage.

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Results are guaranteed on a money-back basis when you use LIGHTNIN Mixers. You get 100% protection—full insurance that the mixer will do the job it is supposed to do. Field experience on thousands of installations, plus 25 years of research in fluid mixing, make this guarantee possible.

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The **Look Box** for November

Petrochemical Handbook

THIS ISSUE of PETROLEUM REFINER is devoted exclusively to the presentation of petrochemical processing information. In it, you will find descriptions of 64 separate petrochemical processes and an equal number of flowsheets covering an even larger number of petrochemicals. In addition, there are seven articles dealing with the industry and with several of the most important markets.

We are certain that this is the most complete coverage of petrochemicals ever presented in one issue of any magazine. It represents the combined efforts of many members of the licensing, contracting, manufacturing companies and the REFINER staff. We feel sure that you will agree that the issue is worth the effort. A limited number of extra copies of this issue are available.

Standardize Jet Fuel

THE RESULTS OF numerous discussions with airline operators and most of the world's leading engine and aircraft manufacturers concerning the fuel which tomorrow's commercial jet transports will use are outlined in a recent article by A. R. Ogston of Esso Export Corporation.

Ogston states: "From the standpoint of a major oil company it is immaterial which particular fuel is supplied for jet transports. Petroleum refining is today a highly flexible manufacturing operation and an oil company is just about equally interested in selling any fuel ranging from bottled propane gas to Bunker C."

The increased costs to the airlines as a result of multiplicity of fuel grades required for piston-engined airliners can be avoided by the adoption of a single grade of fuel that would be acceptable to all airline operators, according to Ogston. He points out that even the latest types of piston-engined airliners require one of three different grades of gasoline depending on the particular model of engine used. The time to avoid these difficulties is now, right at the beginning of this new air transport development.

No Revisions Called For

WE ARE INCLINED to agree with a leading specialist in labor law who said recently at Austin, Texas that the Taft-Hartley law has served its public purpose well and its fundamental and basic principles should be retained.

Charles M. Brooks, labor attorney for The Texas Company and former associate general counsel for the National Labor Relations Board, said in the talk that "no other law in a field of controversial human relations has achieved such a marked degree of accomplishment as the T-H law in its six years." Here is what it has encouraged:

- The continued growth of a free labor union movement with removal of many of the cancerous spots.
- The preservation of individual freedoms and reliance upon ability instead of membership.
- The restoration of balance and equality so as to protect business in the lawful use of its private property.
- The diminution of crippling and demoralizing labor warfare.

The law was needed, Brooks said, to restore a balance in relationship between labor unions and the employers who are required to deal with them. And there is no doubting the need for such a balance after the joy ride provided by new dealers.

Recent elections and opinion surveys reveal that the will of the people today is that our basic labor law should not be materially changed, he added.

Four Wise Men?

THIRTY-TWO YEARS ago, Dr. Sidney Born, president of Born Engineering Company, displaying rare foresight, envisaged the great future of the petrochemical field. In a paper entitled "Petroleum a Raw Material for Our Chemical Industries," which appeared in *Chemical Age* in 1921, he described an *old* plant which had been operated successfully from 1901 to 1907 at Richmond, Va., making ethyl ether from gas oil. From this and other observa-

FACTS ON INFRARED FOR THE PROCESS PLANT

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Through the use of infrared analyzers a continuous check can be maintained on process stream composition. Thus changes in feed stock, catalyst efficiency, reaction rate or final product composition become readily apparent.

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Why not make use of Perkin-Elmer's extensive application engineering facilities? They have been established to provide expert assistance in the application of infrared methods of analysis to specific processes.

Let us show you how your plant operating efficiency may be improved through infrared analysis. Our application engineering facilities are at your service.

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FOR THE PROCESS PLANT—*Model 93 BICHROMATOR* Analyzer* —For continuous control of liquid or gas streams. Records the ratio of any two wavelengths chosen. Thermostatted; enclosed in explosion-proof containers.

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For Optical Design and Electro-Optical Instruments

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tions, Dr. Born made the then incredible prediction that it would be only a short time before petroleum would become a major source of our chemicals.

Passing years and tremendous progress have confirmed Dr. Born's contention.

Now comes two modern-day forecasters: J. H. Eppard and M. R. Wingard, of the Blaw-Knox Chemical Plants Division. In "Chemofining—Petroleum's Future?", a semi-serious paper which they presented at the recent Bartlesville Meeting of the Oklahoma Section of the AIChE, these would-be prophets also take a look into the future at petroleum's role in an increasingly complex technological society. What they see is the utilization of petroleum as a chemical source ultimately superseding its utilization as an energy source.

Between the time Dr. Born foresaw a grand future for the petrochemical field and Eppard and Wingard prophesied an even grander future, R. L. Dudley, publisher of PETROLEUM REFINER, took stock of this field and came up with some ideas of his own on its bright future. That was in 1942, and in August of that year his beliefs were expressed by the addition of the word "Petrochemical," to the front cover masthead of this publication. That word has been there regularly ever since.

And since that August in 1942 PETROLEUM REFINER has led the coverage of this great industry, carrying to its readers the growth so ably predicted by Dr. Born. We will continue to bring you the very best coverage of the future of the growing petrochemical industry—whatever it may be.

Inventories Improving

SHARP CUTBACKS in U.S. crude refining rates have caused improvement in oil inventories during the past month. However, the industry is not completely in the clear from its threatened burdensome stocks position. It must continue to operate at reduced rates for sometime before supplies are brought into proper balance with demand. Runs to refinery stills at late September and early October levels woulld further improve the situation in the coming months.

Runs during the first two weeks of October averaged 6,900,000 barrels daily, a drop of 225,000 barrels from the August level and about 140,000 barrels per day below September's daily rate. Continuation of those levels would go far toward preventing accumulation of excessive supplies during the coming five months.

Some improvement took place the past month in gasoline stocks, although they continued to be high for this time of the year. Gasoline inventories in mid-October were only 1 million barrels less than in mid-July, when normally they would be something like 10 million barrels less. However, there was some improvement during the month.

Motor fuel inventories on October 17 totaled 142¾ million barrels. That was 20¾ million above stocks a year ago. However, they had been 26 million barrels above last year's level in mid-September. Gasoline yields, now about 50 percent, must be reduced to prevent too much accumulation of that product during coming winter off-season months.

Heating oils stocks are in fairly good balance with expected winter requirements. On October 17 inventories of distillate fuel oil totaled 131 million barrels, only 10 million above a year ago.

Assurance For Future

WHAT DOES the post-Korea era hold for the economy of the United States?

First, it would hardly be wise to assume that there will be no readjustment problems if defense spending is cut substantially.

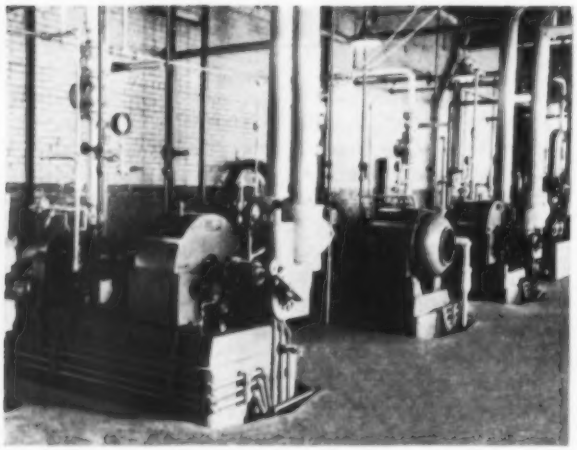
At the same time, "there could be no more dangerous philosophy for the future of private enterprise and a free society than to assume that government expenditures cannot be cut and that high military outlays should be continued indefinitely on a sort of latter-day WPA basis."

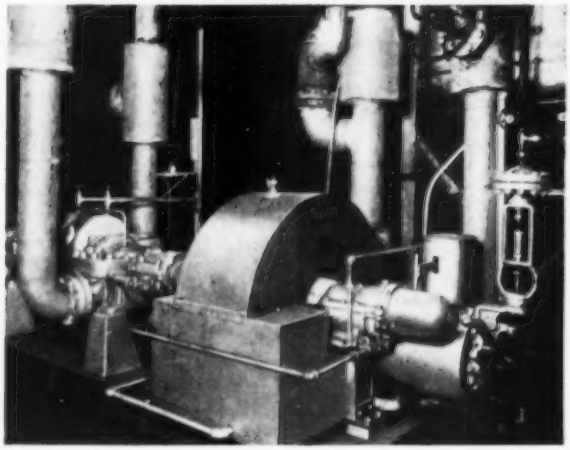
This is the thinking of W. Glenn Campbell, U. S. Chamber of Commerce economist, but it is thinking in which many Americans will heartily concur.

As Campbell points out, "when government spending drops, the total demand for goods and services is reduced. Many people who feel that this will mean a slump or depression fail to realize that lower government expenditures mean that taxes can be reduced and people can thus have more money available for private spending."

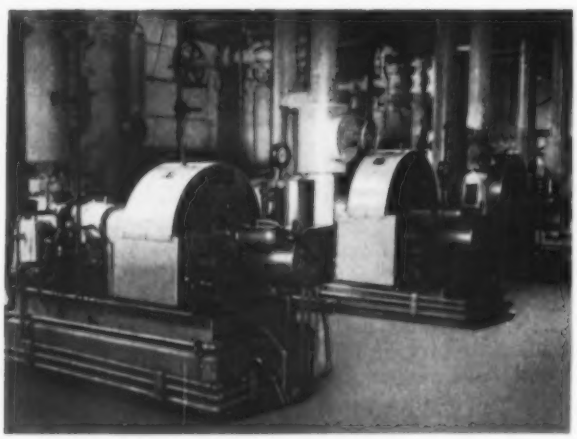
Three Winners

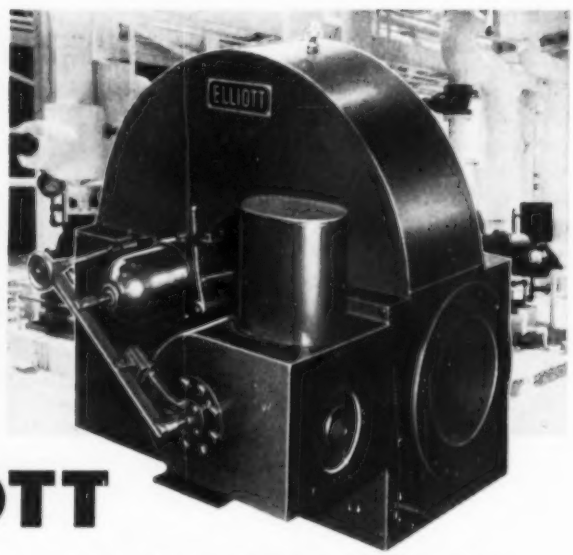
FOR THE BEST paper published in any magazine in 1952, Dr. Kenneth A. Kobe and Dr. William G. Domask have received the South Texas Section AIChE Award and Bronze Plaque. The winners co-authored the masterpiece "Extractive Crystallization—a New Separation Process." Our staff is specially happy because the winner appeared exclusively in PETROLEUM REFINER. The series appeared in the March, May and July Issues of 1952. See the story on page 233.





Because the Industry demands RELIABILITY





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One plant may have a dozen—another, twenty or so—a third, sixty or more. When these turbines go into a plant, their simple maintenance, easy adaptability, and above all, their unquestioned reliability, soon result in repeat orders wherever plant requirements demand further mechanical drive units. "Put in Elliott turbines and forget your troubles" is the usual sound advice one plant manager gives another.

Consider too, the advantages of broad standardization in YR turbine parts, greatly reducing parts inventory. Using the same basic turbine, six different types of governors may be applied to any one of five different frame sizes. These turbines cover a range up to 2000 hp and 7000 rpm.

You can get the turbines you want in the YR line. See your local Elliott engineer or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

STEAM TURBINE DEPARTMENT

M36

Executive Training— Your Neglected Problem?

Part I

Few companies have complete management development programs. Why? Simply because most executives are too busy with today's emergency problems.

David F. Tver,
Director Industrial Relations, Anderson-Prichard Oil Corporation, Oklahoma City

A BUSINESS ORGANIZATION that fails, fails from the top down. Where there is a lack of aggressive leadership, adequate executive replacements, or general stagnation at the top, the enterprise is headed for extinction. A company, in order to survive, must not only have good leadership but also make adequate provisions for qualified executive replacements.

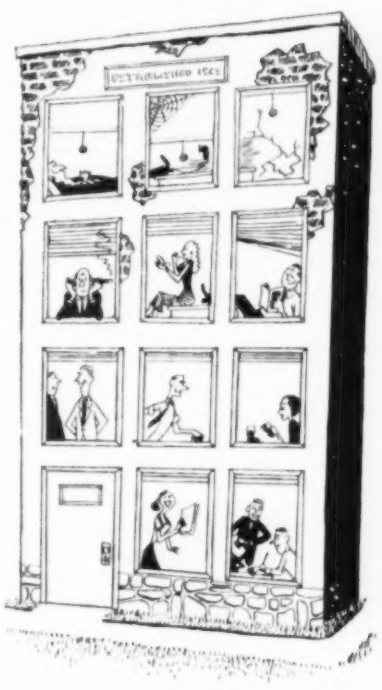
Many of the able executives of companies are near retirement age; others, who once performed their duties well, have lost ground, perhaps because of age or ill health, the job has grown too much, or because they themselves have grown smug and complacent. Only a personnel inventory will bring these conditions to the attention of the business head and enable him to make the changes necessary for the good of the business.

Equally important is an evaluation of secondary or junior executives. Since it is the policy of most businesses to fill vacancies by promotion within, the junior executive of today will be the senior executive of tomorrow. The need for a program for the development of qualified executives is more urgent than ever; especially since there is a definite shortage of men with executive ability, and those with such ability are sometimes reluctant to assume the heavy burden or responsibility required of such positions.

It is important to build a reserve of qualified personnel to back up key positions by developing promising young executives so they will be able to qualify for top positions at an age early enough to contribute maximum service. This would also be a method of testing young executives' competence before they are promoted to key positions. This would have the important effect of improving the morale of the management group, and would attract desirable personnel who would feel that the company offers the proper atmosphere for self development.

Very few programs—However, before management development programs can be discussed, it must be pointed out that very few companies, even today, have complete management development programs. The average executive is so busy with day-to-day problems that he has little time to devote to formal programs, as such. Companies have gotten along without such training and have selected executives on a trial-and-error basis. It is difficult for an executive to admit that he is not developing sufficient executive talent and that a development program is necessary. If it comes, it must come from the president who believes that the company will benefit from such a program. This is not an easy selling job, as the National Industrial Conference Board's report on "Company Programs of Executive Development" points out:

> "A president may subscribe to the idea of executive development, but delay action because he is in the habit of doing business on a crisis or emergency basis. This means that he does not borrow trouble, but waits for something to happen before he acts. Thus, on a certain day when he is confronted with a vacancy of a department head or a vice president, he studies the situation and makes the best possible appointment which the circumstances permit. He has done some thinking about the matter in advance; he has had benefit of counsel of several of his closest associates. A suitable replacement may be available within the company; or a search will be instituted outside. Within a reasonably short period the position probably will be filled. But will it be filled as successfully by this method as by one which includes more thought and planning in advance of need?"



A business organization that fails, fails from the top down.

There are far more articles written today on executive development than ever before. Many, when analyzed, are dressed-up supervisory training programs; others either suggest or expound on the theory. The few concrete and constructive programs still remain in the very large companies—companies which have executive positions in sufficient depth to assure a reasonable flow upward of junior executives. In smaller companies the turnover is low; the promotion to the top level infrequent, occasioned by death or retirement. The important factor to this group is developing its present executives to better utilize their abilities.

In establishing an executive development program, a realistic approach should be taken of how much, how often, and in what manner. All companies undoubtedly realize that it is to the best interests of the organization to have well-prepared men ready to take over where there is promotion to higher levels through termination.

death, retirement, or expansion. Most executives would be willing to take additional training if they thought they had time. It is the selling to executives as to why it is important to take the time that is the most difficult. The companies that have installed programs of this nature realize that the success of any company depends upon the skill and judgment of its executives, and that whatever is done to sharpen these skills and judgments represents a sound investment in the company's future.

Some companies have started limited training programs by the use of consultants; others have encouraged their executives to attend special courses prepared by universities on executive development, one of the outstanding being the Harvard Management Course.

Never too old—More than a few executives respond negatively to such programs because of inflexible or fixed habits, preconceived notions, and those who feel they are in the twilight stage of retirement and that the training would be of little value to them. In most instances these few, by their very nature, need the instruction the most.

Most executives who have become successful have oriented themselves in one direction and have made a success of that particular field. However, the executive that reaches the top today must have a broad background and should be conversant with all phases of company operations. It is for this reason alone that many companies have instituted some phase of executive training. The old methods of selecting exectuives are now being questioned because of the changes that have occurred in business and society; and many companies are re-examining their basic philosophy toward training and selection of executives.

There is an old saying, "The rich get richer and the poor get poorer." That saying can also be appropriate for business. Large, successful businesses invest money in developing the finest equipment, the best salesmen, and the most capable executives. Their success is not an accident. It is preplanned and self-assured. Smaller companies invest capital in machines and equipment, but hesitate to invest in the development of better leadership and ability. But just as in the neglect of physical properties, such a lack of attention can endanger future profits and corporate security. But because these problems deal with intangibles—human emotions, personal ambitions, and executive ability—many executives brush them aside in order to devote more time to "practical" matters. The intangibles cannot be balanced on the ledgers; therefore, the value does not show in the net worth of the company. No estimate is made of the value the company has in its executives and supervisory manpower, its most important asset. Two companies start in business at the same time, with the same assets. Ten years later one has tripled its size; the other is only slightly larger. The difference lies in the ability and leadership of the top executives, the asset that is not on the books.

To be effective, any plan must be tailormade; and the techniques employed must be adapted to the needs of the individual company. However, to do this, certain fundamentals should be considered.

An emergency is no time to select an executive.

- First, the company should determine present and future executive manpower needs. What growth is anticipated in the future? What are the company's policies and objectives as to expansion, new product lines or markets which will create new functions or positions? What effect, at the same time, will cutbacks have on manpower?

- A study should be made of the various executive positions and the basic requirements of the job established. What skills does the position require? Does the position require an unusual degree of planning ability or skill in co-ordinating various related or unrelated activities? What type of physical and mental makeup is desired? Can the individual face the pressure of deadlines; or would he be of more value in a position of less pressure?

- The training programs should be focused on the areas of greatest importance to the company and the development of the individual. All executive positions should be evaluated periodically to study the individual in the position and discover young executives who show the greatest promise for further development. A study and evaluation should be made of the young executive's ability to visualize in perspective, to use practical judgment, react readily to problem situations, presentation of original ideas, ability to get ideas across clearly and convincingly, and whether he has an understanding of human relations. Does he understand how human beings react, and can he motivate them satisfactorily? Does he have that enthusiasm and energy necessary for success? These questions are but a few to ask concerning the ability of the individual.

- A chart should be maintained reflecting an inventory of potential replacements indicating the availability and ready status of qualified executive replacements. To the young executive who shows promise, a program should be planned for individual development to bring him along. In this manner the company will always maintain a reservoir of new blood for executive positions to meet emergencies and provide an adequate source for raw material. This whole program is not a one-shot proposition; to be effective, it must be a continuous process, the scope and extent depending upon the size of the firm and its demands.

This program will not only provide a source of potential leaders but will assure management that the top positions are filled by qualified executives, capable of assuming the responsibilities and authority delegated.

The importance of good leadership is also important from the mental health of the group. Where there is good leadership and guidance; the executive can weld his group into a strong, loyal, and hard-working unit. Those who do not possess leadership ability, even though they have the technical background, will find it difficult to obtain the maximum efficiency and cooperation necessary in good management. The successful executive recognizes the basic worker's satisfaction in a work environment that recognizes the dignity of the individual and provides opportunity for advancement and security of employment which lends one the feeling of participation. Unless management provides good leadership and such environment for all its people, many will turn to leadership intent on collectivism or socialism.

End of Part I. Part II will appear in an early issue.

More POWER *to You* THIS WINTER

NATURAL GASOLINE
PROPANE
ISO-BUTANE
BUTANE
ISO-PENTANE
NORMAL PENTANE
HEXANE
HEPTANE
HEAVY NAPHTHA
STA-VOL-ENE

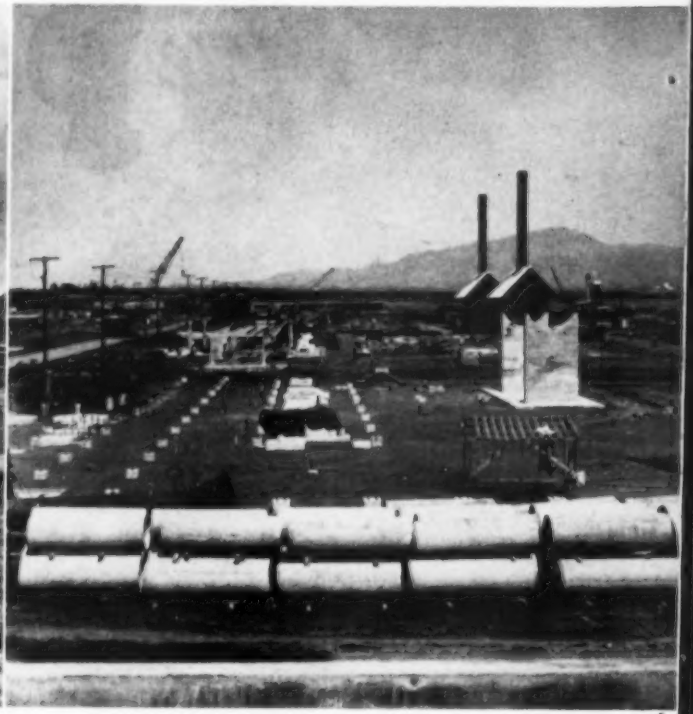
WARREN

PETROLEUM CORPORATION

TULSA, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, SAYBROOK, TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS

The two-stage crude distillation unit is set for earliest completion with . . .



The propane decarbonization unit expected to follow shortly thereafter.

Caltex Plant Shaping Up

Foundations are down and units are springing up in Caltex' race with a late 1954 target date for completion of its $30 million refinery at Batangas Bay.

With the target date for full operation set at late 1954, the Caltex (Philippines), Inc., refinery, on the shores of Batangas Bay, Luzon Island, Province of Batangas, is rapidly taking shape, and indications are that the plant will be completed right on schedule.

The installation, which represents an investment of approximately $30 million, is owned and will be operated by Caltex (Philippines), Inc., a Philippines corporation.

Description. The refinery has been designed to process 13,000 barrels a day of crude oil for the production of:

- Motor gasoline
- Illuminating kerosine
- Automotive diesel
- Industrial diesel
- Bunker diesel
- Land fuel oil
- Bunker fuel oil

The design envisages the possible utilization of crude oil from a variety of sources.

The major processing units will include a two-stage crude distillation unit, a propane decarbonization unit and a fluid catalytic cracking unit. Ancillary equipment will include a steam electric power plant, transfer pumphouse, tankage and transfer lines, an oil wharf, administration offices, maintenance shops, storehouses, a cafeteria and a small hospital and dispensary. Proposed expansion includes the construction of a catalytic polymerization plant.

Site Advantages. Location of the refinery was chosen after extensive engineering and marketing surveys showed that it was the best location from both points of view. On "deep water," the site has good natural drainage, and the subsurface is adequate to support the heavy structures. Accessible to inter-island and ocean going tankers, the site is only 72 miles from Manila, and is readily accessible on excellent hard surfaced highways.

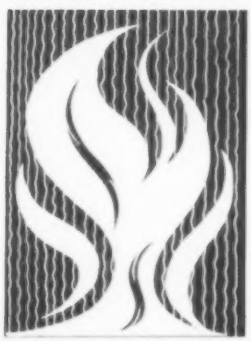
Present Status. All foundations have been installed, most pumps and heat exchangers have been set, and a considerable amount of work has been completed on sewer and separator installations and utilities distribution systems. On the crude unit, scheduled for earliest completion, the process furnaces have been erected, overhead pipe racks are complete, some piping is being hung, and preparations are being made for early erection of the fractionators. The propane decarbonization and fluid catalytic cracking units have progressed only slightly beyond the foundation stage, but are scheduled for completion soon after the crude unit.

Plans have been approved for the

See Caltex Refinery page 265

PETROLEUM
REFINER 1953

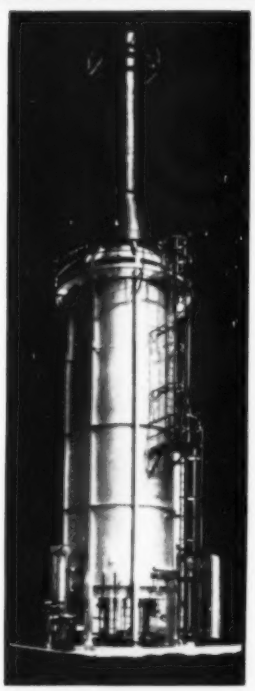
Petrochemical Handbook



.....dollar per dollar

b.t.u. per b.t.u.....

PETROCHEM-ISOFLOW FURNACES



most efficient by any comparison!

simplicity of design and construction

The Isoflow Heater basically is a circular steel shell; this results in an explosion-resistant structure. The shell is lined on the inside with insulation and insulating refractories; this results in a wall with a zero air leakage and high efficiency. The vertical tubes are combined with integral convection tubes; this results in less headers in the heaters for complete cleanability. The integral radiant convection tubes and minimum number of headers result in a minimum pressure drop for a given velocity. The vertical tubes completely shield the walls resulting in low wall maintenance. The small number of headers in combination with the vertical tubes result in ease of cleaning and, if desirable, gang-cleaning of several tubes simultaneously. Individual burners, symmetrically spaced with relationship to the tubes, results in even heat distribution horizontally. The reradiant cone effects even heat distribution vertically. Segregated burners result in ease of firing and inspection of burners. These are some of the design features which place Isoflow Furnaces in a class of their own.

BETTER HEAT DISTRIBUTION

MAXIMUM FUEL EFFICIENCY

LOW PRESSURE DROP

LOW MAINTENANCE

ZERO AIR LEAKAGE

EXPLOSION RESISTANT

MINIMUM GROUND SPACE

SHORT LENGTH OF LIQUID TRAVEL

EXCESS DRAFT FOR HIGH OVERLOAD

PLENUM CHAMBERS FOR HAZARDOUS AREAS

—most efficient by any comparison.

More than 1150 are in operation throughout the world in the petroleum, chemical and allied industries . . . for all processes and for any duty, pressure, temperature and efficiency . . . and all Petrochem-Isoflow Furnaces are pre-eminently satisfactory.

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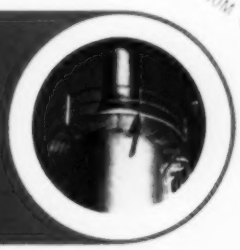
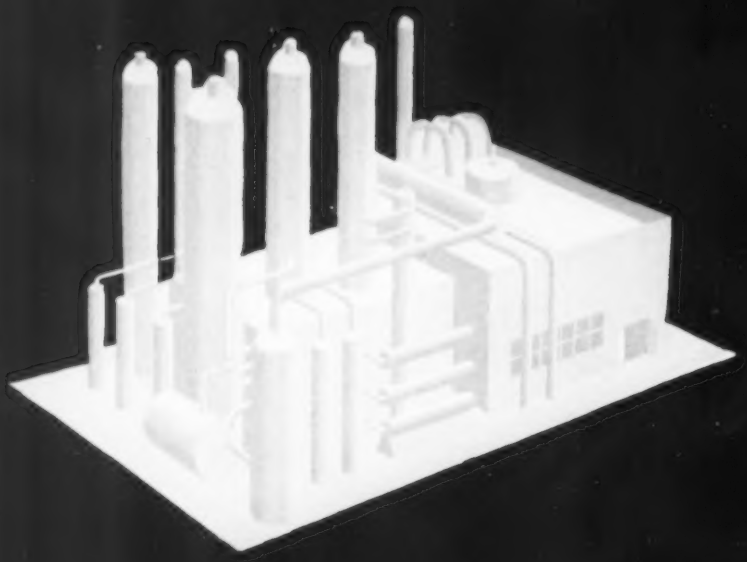


AUTOMATION . . .



will prevent processing headaches

The increasing complexity of petrochemical processing will call for automation beyond today's approach to measurement and control.

Continuous analyzers, for example, point to a significant trend toward "thinking machines," which may ultimately control a whole process on the basis of desired qualities in the finished product. Honeywell has helped to implement this and other new concepts, and will continue to work toward the realization of practical automation.

While the capabilities of instrumentation are being extended, so too is its dependability. For the more automatic a plant gets, the greater becomes the responsibility on the automatic equipment which keeps processes coordinated.

Long identified with instrumentation's parade of progress, Honeywell's Industrial Division serves the petrochemical industry from lab to pilot plant to "on-stream" operation. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for your copy of "How Automatic Can We Get?"— a challenging discussion of the future of instrumentation.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

Foreword

THE 1953 Petrochemical Process Handbook is another first for Petroleum REFINER. Never before has so much petrochemical processing information been published under one cover. This special edition is a round-up of all available information on the most important products produced by an industry which is setting new growth records every year.

Such phrases as "growing young giant" and "industry with a future" are literally true when applied to this industry. Growing with the tremendous increase in production of many new products on a commercial scale in the last 15 years, it has reached its present state of development from its inception on a commercial basis only about 30 years ago.

How large is this industry? The petrochemical industry produced over 21 percent of all the chemicals and more than 70 percent of all organic chemicals produced in this country last year, a production amounting to over 21 billion pounds. The actual value of the petrochemicals represents an even larger share of the chemical market than production figures indicate. The value of petrochemicals produced has been estimated at half of the total value of all chemicals produced last year.

By 1955 petrochemical production is expected to exceed 30 billion pounds with aliphatic chemical production continuing as the backbone of the industry. If this rate of growth is realized, petrochemicals will constitute about half of the total chemical production in this country. This estimate of production is backed up by plant construction which continues at a rapid pace. When plants now under construction or planned are completed, the total number will be in excess of 240 plants in this country. Already more than 140 companies are engaged in or are planning petrochemical operations.

While petrochemical process information has been published in many different publications, much of that information is scattered and in most cases incomplete. The purpose of this edition is not only to assemble information in one issue but also to present process data that have not been published, thereby making it a valuable reference.

No attempt has been made to define the word "petrochemicals." While some will disagree with the classification used, the chemicals presented in this issue are petrochemicals in the opinion of the staff of this magazine.

In addition to the processes presented, seven articles deal with the petrochemical industry and with some of the major markets for the petrochemicals produced.

Presentation of every process used by the petrochemical industry is virtually impossible because of the number. The processes chosen for this handbook are from those used to manufacture the high production chemicals and the high total value chemicals. In some cases it was impractical to present all the different processes used commercially to produce a chemical. For instance, in the production of phenol the newest commercial process is presented along with one of the three older established processes. It is, however, with a great deal of pride that we present several processes never before published.

Petroleum REFINER has covered the petrochemical field for many years, having carried the word "petrochemicals" on its masthead since 1942. It is hoped that this contribution to the petrochemical field will take its place along with the annual Process issue in our reader's reference material. We wish to thank the licensors, engineering contractors and petrochemical producing companies who contributed the material to make this the most complete single source of petrochemical processing information available anywhere.

Editorial Director

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What's Ahead for Petrochemicals?

Executives feel the industry's future is bright but look toward a readjustment period in the next 12 months.

THE PETROCHEMICAL INDUSTRY will shortly enter a readjustment period resulting from enormous expansion and demanding the utmost in efficient, clear-sighted and courageous management.

This was the near-unanimous opinion of executives asked by PETROLEUM REFINER to point out some of the major problems and challenges which must be met in the next 12 months.

The period of expansion which has not yet reached its fullest intensity will lessen the imbalance in supply and demand within the next few months, the executives declared. This will exact its toll from plants with obsolete or high-cost processes; it will work a hardship upon those who cling to the techniques of a seller's market; and it will penalize those who are not alert to increased quality of products.

But, declared those who participated in the symposium, the months ahead will present a magnificent opportunity to those with the courage to look beyond the adjustment period and the initiative to improve their positions by increasing efficiency, reducing operating expenses, and improving the quality of products by diligent research and development.

The statements of the executives follow:

GEN. BREHON SOMERVELL
Chairman and President, Koppers Company, Inc.

For the year ahead and probably for many years ahead, solid and substantial growth is anticipated for the nation's petrochemical industry.

Somervell

It would be difficult to see how anything can hold back this development. Chemical companies, oil companies and companies that produce chemicals from coal, all are highly conscious of the potentialities. Yet, to all intents and purposes, the field has scarcely been tapped.

Starting with the stream from refineries, chemicals can be obtained that can be made into many thousands of products. The oil industry is now alert to this potential and is making such chemicals available to the chemical industry in increasing amounts.

An example of this is ethylene, now being recovered from a large number of refineries throughout the nation. Availability of ethylene from Texas refineries resulted in Koppers building a plant there to combine ethylene and benzene. Other companies likewise are building in the southwest to utilize the vast supply of oil chemicals.

The President's Material Policy Report indicates an eight-fold growth rate for the chemical industry between 1955 and 1975. If this comes, and we believe it will, much of the growth will be in the petrochemical field.

R. C. McCURDY
President, Shell Chemical Company

Shell Chemical Corporation during the next 12 months is going to put two new petrochemical plants on stream and start the construction of a third. Such continuing expansion is the best testimony I can give as to our views on the future of the industry.

McCurdy

The days of easy selling are just as much in the past for the chemical industry as they are for many others. The coming year may be one of harder work for all of us.

But we are sure of the need of the American people for increasing quantities of the things that only the chemical industry can produce, and that's why much of our attention is directed towards further petrochemical expansion.

JOHN P. COE
Vice President, United States Rubber Company

The petrochemical field in which the rubber industry is most concerned is synthetic rubber. And the most exciting development in this field just ahead of us is the pending release of the synthetic rubber plants to private industry.

Coe

To us who for many years have recommended the step, it is encouraging that Congress has now fixed a definite pattern for disposal of this government-owned industry.

Positive action on synthetic rubber at this time is essential. It needs the incentive of free enterprise to meet the coming challenge of increasing demand in quality as in quantity.

Some people may have concluded that the current slackening in synthetic rubber production marks a swing toward natural rubber and away from synthetic. They should realize that the trend is minor and only temporary.

In the years ahead the consumption of synthetic rubber can only increase. Within the next ten years we estimate conservatively that world demand for rubber will reach 3,200,000 long tons a year. Natural rubber production will perhaps be 1,700,000 tons. Synthetic rubber must fill the gap of 1,500,000 tons, and that is considerably more than the present synthetic rubber efficient capacity.

Future consumption of synthetic rubber in increasing quantities is just as assured as the consumption of gasoline.

GEORGE L. PARKHURST
Vice President, Standard Oil Company of California, and chairman, Oronite Chemical Company

Parkhurst

During the past several years, rapid advances in technology in both the petrochemical producing and petrochemical consuming industries have supported a tremendous program of expansion in manufacturing facilities. I feel that this expansion has been, and is, sound. The forthcoming 12 months will see many new plants coming on stream to swell the supplies of many industrial organic chemicals. It seems likely that in some instances, temporary dislocations of the supply-demand relationships may result. Our competitive free enterprise system can take such developments in stride. I foresee no prolonged upset.

That the future holds promise of continued growth in this dynamic industry is confirmed by the substantial and increasing amounts budgeted for research and development by the individual firms comprising the industry. Such funds are employed both in the search for new and improved methods of production and utilization of well established commodities and in the search for new and useful compounds and compositions. Progress can be anticipated in both directions.

The early history of the petrochemical business was largely one of rapid expansion in the field of aliphatic or "open-chain" chemicals. The main reliance for aromatic and other ring-structure chemicals continued to be the coal tar industry. In recent years petrochemical sources of aromatic chemicals have become increasingly important. The petroleum industry is now the main source of toluene and xylene and its production of benzene has become highly significant. The year 1954 will see new plants in production. Moreover, commercial derivatives of these and other aromatic hydrocarbons are being developed rapidly by companies active in or affiliated with the petroleum industry as well as by the older chemical companies.

Perhaps the most significant trend in petrochemicals in 1954 may be expected to be the increasing activity in synthesis and recovery of these aromatic hydrocarbons and their manifold derivatives. Thus, the door to all organic chemistry may now be considered open to the petrochemical industry.

KENNETH A. SPENCER
President, Spencer Chemical Company

Spencer

The companies in the petrochemical industry, unlike most industrial groups, are related largely by common raw materials rather than by common products and markets. It is accordingly difficult to generalize on many aspects of the industry's future prospects. During the coming year, however, many segments of the petrochemical industry will have another characteristic in common—namely, substantial increases in productive capacity as the result of the numerous new plants now under construction. Under more normal circumstances such additions to productive capacity would be expected to be rather gradual and intermittent, but owing to the NPA's "program method" of issuing Certificates of Necessity, we face a situation in which a large number of new plants will be completed at approximately the same time.

As a result it is reasonable to expect that demand for such products will continue to exceed supply during the early months of the coming year, only to be brought sharply into balance by a sudden increase of production capacity. Therefore, while the industry may experience some difficulty in meeting some of its customers' requirements during the early months of 1954, the supply of most petrochemicals should be adequate by the end of 1954 and may temporarily exceed demand by 1955.

In anticipation of the time when the demand for petrochemicals for present applications will have been met, the industry must devote increased attention to the development of new products and new uses for its present products. I am sure that a more intensive application of the industry's excellent research facilities and technical know-how to this problem will result in accelerated progress in this direction. Industry-wide recognition of the fact that supply of some petrochemicals may temporarily exceed demand may well stimulate development of new uses and new markets capable of absorbing the additional production without serious dislocation.

DR. LELAND I. DOAN
President, The Dow Chemical Company

Doan

As another business year approaches, we of the petrochemical industry—and all industry, for that matter—have an unparalleled opportunity for leadership in showing the nation that we are equal to the job of carrying our economy further along the road to prosperity despite any reduction in government spending.

We have been asking for that opportunity for some time. In answer to the negative thinking of those who foresee a business recession resulting from any drop in government spending, we have a golden chance to demonstrate that we can generate—within our competitive industrial economy—many uses for our already enormous and steadily increasing capacity to add to our national well-being.

Our big job—our whole end and aim for years to come—is to prove to ourselves and to the world that private industry can continue to raise living standards in this country. If we do that we will have no worries about taking up the slack caused by a drop in public spending.

While some people are thinking in terms of deflation—as an antidote why should not industry think in terms of inflation? To be sure, we have decried inflation—the kind we have seen in the last ten years. However, the kind of inflation we would find in plotting a curve over, say, 50 or 100 years is something else again.

Perhaps a better word for that type of inflation is *growth* or *progress*. Historically, our progress curve has been on the upgrade—progress from the standpoint of higher wages, increased research and production and a higher standard of living. The objective of all industry should be to see that this curve continues upward.

The point is that we hear too much talk about deflation, about lower prices. Rather we should think in terms of greater value for the same price. Deflation is pessimistic. It breeds hesitancy—a waiting for tomorrow in hope of a better bargain. That sort of psychology slows the wheels of industry and of progress.

Inflation, by contrast, is optimistic

Petrochemical Process Handbook

Say petrochemical industry expansion yet to reach its fullest intensity

and, over the long pull, symptomatic of growth and achievement. Furthermore, it is easier to control inflation than deflation.

We are all aware that the kind of inflation we have known in recent years has been expensive, hazardous and has worked severe hardships upon certain segments of our society. Let us, by all means, try to insure that this does not happen again. But on the contrary let us not think in terms of turning back. Rather can we not find means of alleviating the injustices that have been done and proceed forward, more judiciously, from the point on the curve where we now find ourselves?

Private industry has the opportunity to lead our nation on to greater accomplishment. Let us make certain that history will record we were equal to the job.

ROBERT B. SEMPLE
President, Wyandotte Chemicals Corporation

Our company occupies a position in the chemical world that is becoming more and more usual—a producer of inorganic chemicals that has become established in the petrochemical field as well. Consequently, the future of the petrochemical industry is of direct importance to us, rather than being concerned with its future as a supplier of raw materials.

Semple

There is no question in our minds that during 1954, and for a number of years after that, the volume of products produced by the petrochemical industry will grow at a fast rate. The possibilities of new products being produced by ethylene chemistry have certainly not been exhausted; the products that will be made in the future by use of the other known, but as yet not well explored, basic starting compounds such as acetylene and butadiene are going to add to this volume of new products in an ever-increasing amount.

With this realization in mind, we currently and during 1954 plan to devote a large portion of our research dollars and time to new developments in petrochemicals, as will virtually all companies that occupy a position similar to ours. Considerable effort will also be expended to make better products from existing facilities, and if possible, at a lower cost. Competition among producers of petrochemicals, in general, will tend to become keener during 1954 and to maintain satisfactory profit margins, many producers will have to eye their costs critically.

One major change in the physical aspect of the industry is becoming evident. For some years, the trend was for chemical companies to install facilities near the major refining centers of the southwest in order to pull basic petro products directly from source plants into chemical manufacturing units. The increase in efficiency of pipe lines and the rapid growth of the nation's pipe line network are developing a new trend by making basic petro products available to chemical companies in virtually any chemical center which may be near transmission facilities. Already important new chemical plants have been located in places where they can strip their petro requirements from oil lines and indications in the chemical industry are that growth of this trend will become more evident. The pipe line pattern follows population. This very fact is important to the chemical industry because it, too, must give more attention to migration toward major centers of use of its products. Decentralization of petrochemical operations is highly important from the civilian use and distribution standpoint as well as defense viewpoint. The more petrochemical operational centers we have functioning throughout industrial America, the less vulnerable we shall be to loss of vital military material in event of destruction of one of the present huge concentrations of productive capacity such as those in the southwest and on the Pacific Coast.

In another potential area of change, the entire petrochemical industry will be watching during 1954 for any developments that are released by Carbide and Carbon Chemicals concerning their coal hydrogenation process. This process may in the future, cause much reevaluation in the industry with regard to the best and cheapest source of raw materials upon which the industry is based. No long range planning for petrochemical expansion should neglect this possibility. Doubtless there will arise two schools of thought as to whether these raw materials are best obtained from coal or oil and perhaps this process will color the petrochemical picture for 1954 more than any single development that has been evolved in 1953.

The two great basic industries—oil and chemical—working together on many projects and independently on many others, will continue to contribute importantly toward a better America and a better world.

P. M. DINKINS
President, Jefferson Chemical Company, Inc.

The tremendous growth of the petrochemical industry during World War II, and in the period since, is, of course, well recognized. Immediately following the war, in fact, many organic chemicals were in such short supply that producers were hard pressed to meet the demand. With the rapid completion of new production facilities, however, and some leveling off in consumption, there has occurred a fairly rapid shift to a buyer's market in petrochemicals. While the outlook is for a continuation of this trend during 1954, generally healthy business activity is foreseen.

Dinkins

A review of the 1952 annual reports of many chemical companies shows a drop in net income after taxes from 1951, continuing a decline begun in that year. While preliminary figures for the first half of 1953 indicates some reversal in the trend of declining profits, earnings have by no means recovered to the levels prevailing in 1950. Reduced earnings have been caused partly by the fact that prices have been held down by price controls during a period of rising costs for labor, raw materials and transportation, as well as steadily increasing taxes. But even in the face of this situation, it is clear that chemical companies must continue to spend large sums for research and development.

The challenge is clear. The year 1954 will demand the utmost in efficient, clear-sighted and courageous management. Those in responsible positions will recognize this as a necessary period of adjustment after a decade of unprecedented growth, and will profit by the opportunity it affords to take a long look both ways. I am sure that for this young industry, operating in a sound and vital economy, the period of adjustment will not be a long one.

PAUL ENDACOTT
President, Phillips Petroleum Company

The petrochemical scene for 1954 seems to be primarily one of consolidation with expansion on a sonsiderably more selective and somewhat less ambitious scale. Further improvement of product, increased efficiency, and reduction of operating expenses appear to be the major considerations. Volume should continue to increase in most lines but profits will be confronted with the necessity of hurdling higher manufacturing costs.

Endacott

Major petrochemical projects scheduled for completion in 1954 will raise output of ammonia and nitrogen fertilizer products, acetylene and its derivatives, ethylene polymers, phenol, acetone, and improved varieties of synthetic fibers and synthetic rubbers. Continued attention will be given to the preparation and selection of petrochemical feed stocks, the most important of which are the light hydrocarbons and natural gas.

The government's plans for disposal of synthetic rubber plants should stimulate petrochemical activity where feed stocks and component materials used in synthetic rubber manufacture are involved. Important advances in synthetic rubber probably will be made with private research money, although until the plants have shifted to private ownership emphasis will be on projects falling outside the scope of government operations.

As yet no clear-cut boundaries of the petrochemical industry have been defined and what one company or individual regards as a petrochemical product is frequently not so classified by another. This confusion is not to be wholly unexpected during the present period while the chemical industry is engaged in abandoning some of its traditional sources of raw materials in order to take advantage of petroleum sources, and while the oil industry is shifting to chemical manufacture substantial portions of its particularly adaptable feed stocks.

Comparison of oil company earnings from pertochemicals is difficult because of variations in practices for allocating costs. Arbitrary assumptions for pricing charging stocks and allocating direct and overhead expenses are unavoidable. This is especially true where chemical operations are closely integrated with refining operations.

The exact state of health of the petrochemical industry in 1954, of course, will depend upon general economic and industrial conditions throughout this country and the rest of the world. If industrial output continues at or near present levels, demand for petrochemical products will be sustained by the purchasing power of high-level income.

E. J. THOMAS
President, The Goodyear Tire & Rubber Company

One of the biggest chemical activities of the rubber companies is in the manufacture of synthetic rubber.

Consumption of synthetic rubber in the U. S. in 1954 will continue at about the 1953 pace which is expected to hit around 800,000 long tons by the end of the year.

Despite the fact that synthetic consumption in 1954 will remain substantially at the 1953 level, it must be remembered that the current year will go down as an abnormally high 12-month period insofar as synthetic is concerned.

Synthetic supply at the present time appears to be ample and it definitely looks like supply will stay abreast of demand during the coming year.

Tires represent one of the biggest outlets for synthetic rubber and although a slight drop is expected in new car output, an anticipated boost in the replacement tire market may offset any loss in this category.

Thomas

Another factor contributing to the status quo forecast for synthetic is the predicted outlook for fairly stable rubber prices, both natural and synthetic, during the coming months.

Of course, any sharp change in the natural rubber picture will affect the synthetic forecast. At the present time, the ratio of all new rubber consumed by the industry is about 60 percent synthetic and 40 percent natural, a ratio expected to continue next year.

Total rubber consumption in the U. S., including both natural and synthetic, is expected to reach about 1,315,000 long tons in 1954.

This represents a drop of about 83,000 long tons from the anticipated and unusually high 1953 consumption.

Actually, the industry is looking forward to another above-average year in synthetic activity.

R. E. HULSE
Vice President, National Petro-Chemicals Corporation

The year 1954 should witness a continuation of the expansion of the petrochemical industry which has grown so spectacularly over the last decade, because of the large demand for cheap basic chemicals, and the government's accelerated tax amortization program. Much of this expanded capacity has already come into production or will come into production in 1954, resulting in some temporary overcapacity of a number of petrochemicals until demand catches up with supply.

Hulse

In an industry with so many varied products, processes, and companies, it is only natural that occasionally some dislocation of supply and demand will occur. This is more likely to happen during periods of rapid expansion such as we have just experienced. Competition will be most intensive in those petrochemical products where productive capacity has temporarily outstripped demand. Under such conditions of competition, quality of product will again play an important role. Some price concessions and cutbacks in production may be necessary where quality of product fails to meet that of a competitor's.

Producers who are dependent upon others for raw materials will be at a serious disadvantage in comparison with those producers who have a basic position in natural gas or petroleum refining.

Integrated companies will have a cost advantage in ethylene, acetylene, and the other building blocks which will enable them more successfully to keep their plants operating at profitable levels during the period of surplus capacity which appears to be just ahead. In time the petrochemical industry will be dominated by the large petroleum and chemical companies who can afford the large investments required for successful petrochemical projects. We forecast that 1954 will show this trend on new projects.

Petrochemical Process Handbook

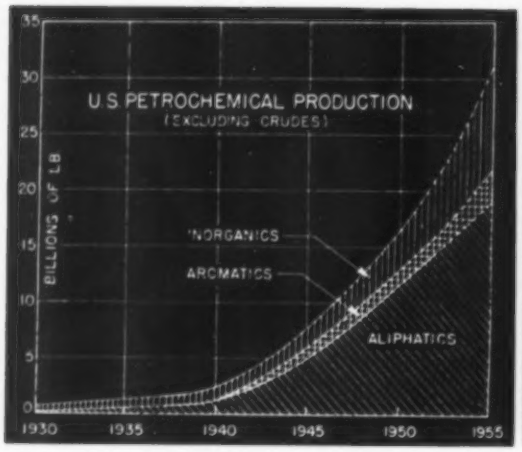

Figure 1. U. S. petrochemical production (excluding crudes)

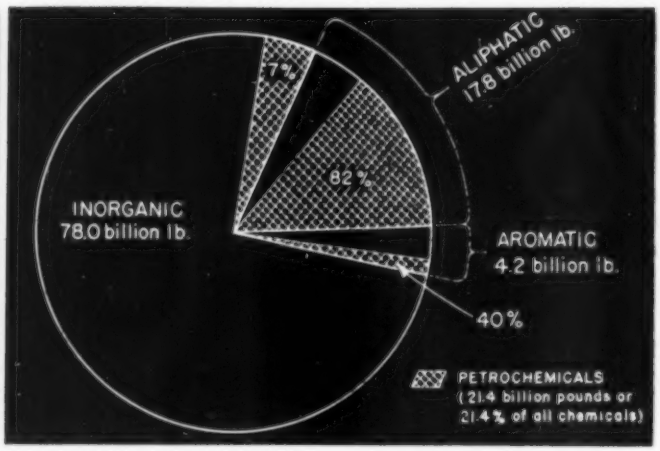

Figure 2. Total production of chemicals in the United States for the year 1952

An over-all picture of . . .

The Petrochemical Industry

- Growth
- Production
- Future Expansion

THE LAST 35 YEARS or so have seen the development of a major new industry within an industry. This new industry—petrochemical—now supplies more than 21 percent of the chemical production in this country. This percentage is based on total chemical production as pounds per year. It is expected to supply 50 percent by 1965. An indication of the rapid growth of the industry can be seen in Figure 1.

Union Carbide and Carbon Corporation and Standard Oil Company (New Jersey), known as Esso, began the production of petrochemicals in the 1920's. Since this initial production, however, the name of the products has been changed from "synthetic aliphatic chemicals" to "petrochemicals."

The tremendous growth can be attributed directly to the development of new products or chemicals, and to the need for new and additional raw materials caused by the pressure of an expanding economy. The abundance of raw material at a relatively stable price resulted in large expenditures for research and in the commercial development of large outlets for petrochemicals.

Petrochemical Production—The total production of chemicals in this country amounted to 100.4 billion pounds in 1952. The production of petrochemicals amounted to 21.4 billion pounds during the same period. This means that 21.4 percent of all chemicals were produced by the petrochemical industry. The petrochemical production of the various classes of chemicals is shown in Figure 2.

Aliphatic Petrochemicals—On the basis of annual production, more aliphatics are produced than any other class of petrochemical. Of the entire country's production of 17.8 billion pounds of aliphatics, 82 percent were produced by the petrochemical industry. The petrochemical production, then, amounted to 14.3 billion pounds in 1952. The C_3 and C_4 hydrocarbons were the source of the majority of this production. Most of the other 18 percent came from coal and agricultural products.

Aromatic Petrochemicals—The aromatics are much newer additions to the petrochemical family than are the aliphatics. Humble Oil & Refining Company and Shell Chemical Company first began the production of these

THE TOTAL production of chemicals in the U. S. amounted to 100.4 billion pounds in 1952. The production of petrochemicals amounted to 21.4 billion pounds during the same period. This means that 21.4 percent of all chemicals were produced by the petrochemical industry.

petrochemicals about 1940. They consist primarily of the aromatic "crudes" such as benzene, toluene, and xylene. From these "crudes" are derived the other chemicals such as phenol, styrene, and aniline which can be called "intermediates."

The total production of aromatics intermediates was reported by the U. S. Tariff Commission to have been 4.2 billion pounds last year. Of this total about 40 percent were of petrochemical origin. This would make a total of 1.7 billion pounds of aromatics produced in 1952 by the petrochemical industry.

Inorganic Petrochemicals—Natural gas is the basic raw material for most of the inorganic petrochemicals. The major petrochemicals produced from natural gas are ammonia, carbon black, and sulfur. It is estimated that of the 78 billion pounds of inorganic chemicals produced in 1952, about 7 percent or a total of 5.4 billion pounds were petrochemicals.

The importance of natural gas as a raw material for the inorganic petrochemicals can be illustrated by the following figures. The Bureau of Census reported the total ammonia production as 2.05 million long tons. Of this production it is estimated that 1.2 million tons were made using natural gas as the starting material. Almost the entire production of carbon black, which amounted to 1.3 billion pounds, came from natural gas. Natural gas or petroleum accounted for an estimated 5 percent of the total of 6.36 million long tons of sulfur produced last year. This would mean 318,000 long tons of sulfur.

Production of Major Aliphatics—The bulk of all petrochemicals produced in 1952 were aliphatics. This class of petrochemical amounted to 70 percent of the total production. Figure 3 shows production curves for several of the most important aliphatics. The period covered is from 1945 to 1955. The figures include the production of these chemicals from all sources. Ethanol production in 1945 amounted to 3300 million pounds of the industrial grade, produced by the beverage industry and by the fermentation and synthetic processes. This large output was needed that year for the synthetic rubber program. Of the 1952 totals, it is estimated that 57 percent of ethanol, 90 percent of methanol, 95 percent of acetic acid, and 20 percent of glycerol was petrochemical. All of the ethylene oxide and glycol was petrochemical production. Table I gives the production figures for 1952 for some of the various groups of aliphatic chemicals.

TABLE 1.
Production of Major Aliphatics by Chemical Family
(Billions of Pounds in 1952)

Family	Total	Petrochemical	Largest Member of Family	Total	Petrochemical
Hydroxy Compounds	5.0	4.1	Ethanol	1.52	0.86
Aldehydes & Ketones	2.4	2.0	Acetaldehyde	0.63	0.59
Halogenated Compounds	2.6	2.4	Ethyl Chloride	0.44	0.43
Acids & Anhydrides	1.2	1.1	Acetic Anhydride	0.69	0.69
Esters & Oxides	1.3	1.0	Ethylene Oxide	0.68	0.68
Amines	0.6	0.3	Hexamethylene-diamine	0.08	...

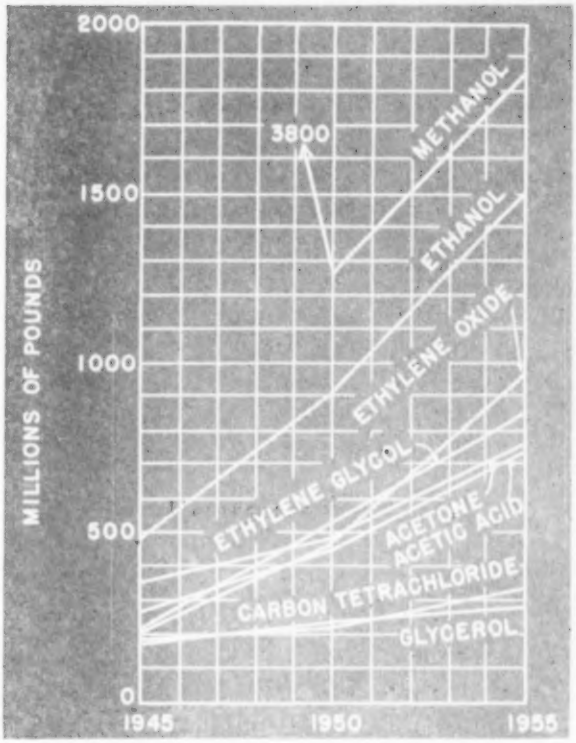

Figure 3. Total production of major aliphatics.

Basic Processes Developed—The tremendous expansion and growth of the petrochemical industry has largely been the result of extensive research and the constant development of new and improved processes. Figures 4 through 7 indicate how the petrochemicals are derived from raw materials.

Figure 4 shows the various steps that may be used to form several important petrochemicals. The basic raw materials, such as ethane, propane and butane are derived from petroleum or natural gas. These compounds are converted into olefins by cracking processes. Esso was the first to utilize these olefins by hydrating propylene to isopropanol. In this process the propylene is absorbed in sulfuric acid with subsequent hydrolysis to the alcohol. The next important process for hydrating olefins came 25 years later when Shell introduced the process for the direct hydration of ethylene.

Union Carbide was one of the pioneers in the halogenation of ethylene to form ethylene dichloride and the hypohalogenation of ethylene to form ethylene chlorhydrin. Ethylene chlorhydrin is an intermediate in the production of ethylene oxide and glycol. Shell uses a different type of chlorination process. In one of their first steps in the production of synthetic glycerol they use a process for the hot chlorination of propylene. The direct oxidation of ethylene to the oxide was first accomplished by Union Carbide about 1937.

The manufacture of styrene by alkylating benzene and olefins to form ethyl benzene and subsequent dehydrogenation was the first large scale alkylation process. Esso

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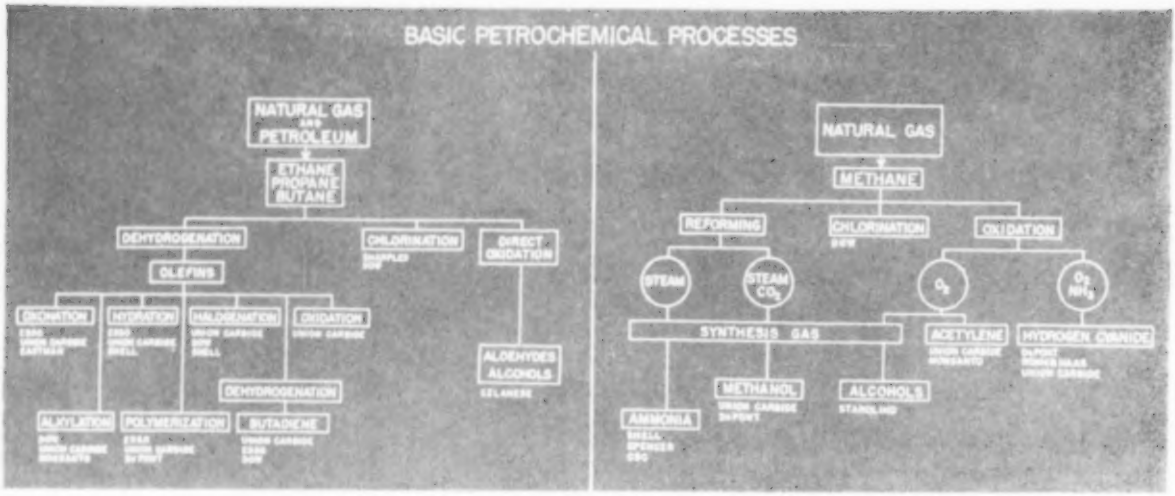

Figure 4. Using ethane, propane and butane.

Figure 5. Using methane.

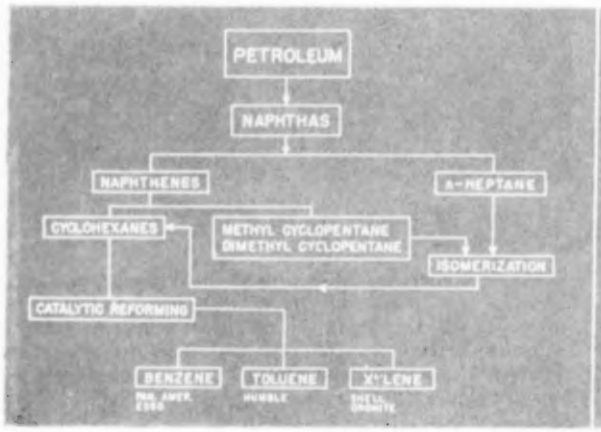

Figure 6. Using naphthas.

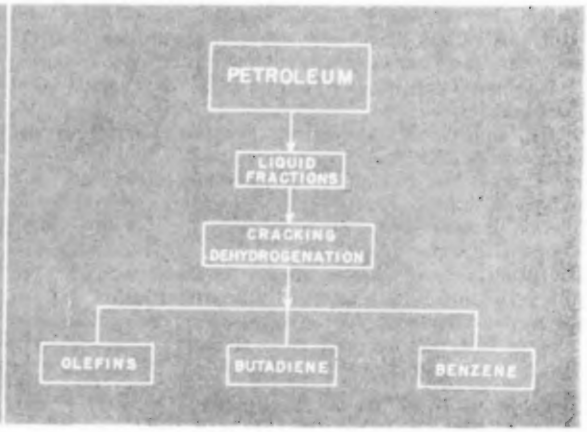

Figure 7. Using selected liquid fractions for cracking stock.

began the first polymerization of olefins to form polyisobutylene around 1940. Union Carbide and Carbon Corporation and E. I. duPont de Nemours and Company began the manufacture of polyethylene shortly after this initial polymerization process. Butadiene is synthesised mainly by the dehydrogenation of olefins. Oxonation, which was developed in Germany, is the most recent commercial process utilizing olefins. Since the war Esso started operation of the first commercial plant in this country. The same process is used by Union Carbide and Texas Eastman for the synthesis of aliphatic chemicals. Gulf Oil Company and Standard Oil Company (Indiana) expect to have commercial plants in operation in 1953.

Sharples Chemical Inc., was the first to employ a process for the direct chlorination of paraffins without first dehydrogenating to the olefins. This operation was started in the mid 1920's.

During the last ten years, Celanese has used a process for the direct oxidation of propane and butane to aldehydes, ketones and alcohols. These chemicals are then converted to other aliphatic chemicals such as acetic acid, acetic anhydride, n-butyl alcohol, and propylene glycol.

Much of the recent expansion of petrochemical processes has been toward utilizing methane for the production of synthesis gas—carbon monoxide and hydrogen. (See Figure 5.) In the early 1940's Union Carbide started production of the first methanol from methane. duPont later built several plants in Texas for the production of methanol from methane. Since the war, methane has become the largest source of hydrogen for the production of ammonia. Methane was used by Shell around 1931 to produce ammonia, but the process used methane as a source of hydrogen rather than to produce synthesis gas. Carbide and Carbon Chemicals Company, division of Union Carbide, uses the partial oxidation of methane to produce acetylene at Texas City. Shortly after this operation was begun in 1950, Monsanto started operation of a similar process to make acetylene for their acrylonitrile operations. The synthesis of hydrogen cyanide utilizing the oxidation of methane was developed by duPont in the 1930's. Three other companies, Union Carbide, Monsanto Chemical Company and Rohm & Haas, now have commercial units using this process.

The cracking operations of the petroleum industry not only are a source of olefins, but they are also the source of naphthas. From these naphthas can be separated naph-

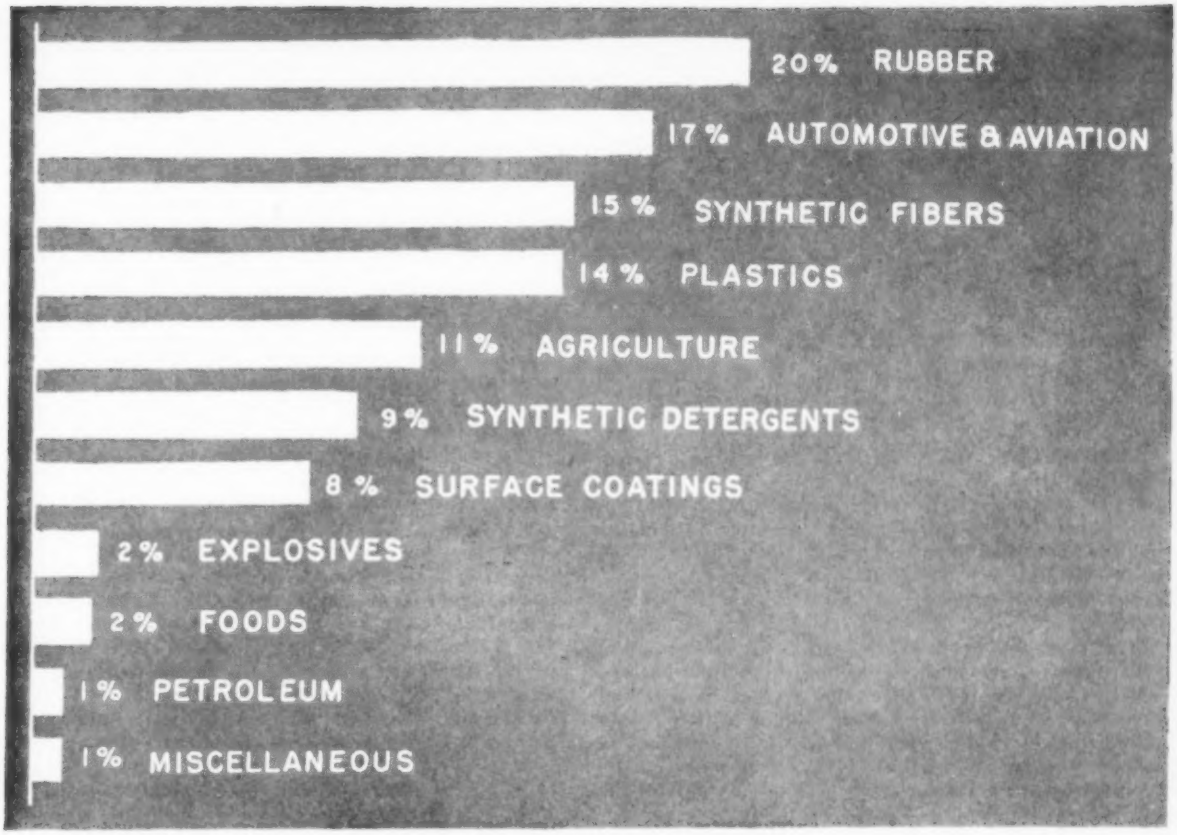

Figure 8. Petrochemical end-uses.

thenes or cycloparaffins and aliphatics such as heptane. Figure 6 traces the steps in the utilization of these raw materials for the production of petrochemicals. By various refining methods, the cyclohexanes and substituted cyclopentanes can be separated from the heptanes. By an isomerization reaction, these substituted cyclopentanes can be converted to cyclohexanes. These cyclohexanes are, then, converted by either catalytic reforming or platforming to such aromatics as benzene, toluene and xylene. By suitable refining methods a portion of the heptanes can be converted into the cyclic form and dehydrogenated to benzene, toluene and xylene.

In some cases the petrochemical raw material can be produced from petroleum by the cracking or dehydrogenation of selected liquid fractions. This is illustrated in Figure 7. The olefins produced can be converted directly into petrochemicals by the processes shown in Figure 4. Some companies are planning to up-grade their low value liquid petroleum residues into these raw materials for petrochemical operations. The primary products of the process shown in Figure 7 are the lower olefins with the butadiene and benzene normally considered more in the nature of by-products.

Additional information on specific processes may be found in the process descriptions of this issue.

End Uses for These Petrochemicals—A breakdown of end uses for petrochemicals on a tonnage basis is shown in Figure 8. The largest consumer of petrochemicals is the synthetic rubber industry which uses 20 percent of the petrochemicals produced. This industry makes use of butadiene, styrene and carbon black. The use of many petrochemicals, but primarily anti-freezes and anti-knock fluid, makes the automotive and aviation industries the second largest consumer of petrochemicals. The plastics industry uses petrochemicals in various ways. Large quantities of acetic anhydride and acetone are used in the manufacture of cellulose acetate. Benzene, cyclohexane, and butadiene are the basic materials for the manufacture of nylon. Some of the newer synthetic fibers use petrochemicals such as ethylene glycol, terephthalic acid, acrylonitrile and vinyl chloride.

Many other uses of petrochemicals may be found in the process descriptions in this issue.

The substance of this article is derived from material presented by R. L. Bateman and J. A. Field before the American Chemical Society in Chicago during the September, 1953 meeting.

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Petrochemical Process Handbook

The role of petrochemicals in . . .

Synthetic Detergents

The production of petrochemical-based synthetic detergents is expected to exceed 1.3 billion pounds this year.

Foster D. Snell, Foster D. Snell, Inc.
New York

COMMERCIAL INCEPTION of the synthetic detergents industry in 1932 was based on fats. Yet even before that the literature showed surfactants which could be synthesized from petroleum and thereafter formulated for sale. The significance of petroleum in the field was not great up to World War II simply because the whole production was small. They would not wash cottons clean.

The discovery in the early 1940's that formulation with massive amounts of sodium tripolyphosphate—usually more than twice the amount of surfactant used as active agent—would permit washing cottons clean opened up the field. When released from wartime restrictions it mushroomed. And petrochemical manufactures have been getting a steadily increasing part of the business.

Since detergents are cleaning materials, whether soap or synthetic detergents, the confusion which arises in popular abbreviation of synthetic detergents as "detergents" will be avoided by referring to them here as "syndets."

Growth of the Industry—When the writer in 1947, with production at the 250 million pound level, dared to predict a billion pound syndet market by 1950 there were many skeptics. It happened to be almost exact. Now the talk is of a two-billion, three-billion, and even four-billion pound markets. The two-billion level may be passed in 1953 with sales of over 900 million pounds in the first half of the year, and surely will be exceeded in 1954.

The U. S. population uses around 25 pounds of detergents—soaps and syndets—per person annually or a little more than four billion pounds per year currently. Little increase can be expected, it's already the largest in the world. Therefore aside from export markets, increase in the total use depends on population growth or new uses. In 1951 syndets had 37 percent of the total market, in 1952 43 percent, in the first six months of 1953 they had 53 percent of the market. Even the most optimistic prognosticators do not suggest complete replacement of soap by syndets. They vary in their opinions as to the degree of replacement. An interesting development in 1953, unfavorable to soap, is the sale of a few familiar soap brands as syndets rather than soap.

PETROLEUM cannot be expected to take all of the field. That it dominates, however, is shown by the percentage of the syndets which were petroleum derived: 1944—49 percent; 1950—58 percent; 1951—66 percent; 1952—65 percent.

The next subdivision of the market is between fat-derived and petroleum-derived syndets complicated by the fact that some alkylate is from petroleum benzene, some from coal-tar benzene. Petroleum cannot be expected to take all of the field. That it dominates is shown by the percentage of the syndets which were petroleum derived: 1944—49 percent; 1950—58 percent; 1951—66 percent; 1952—65 percent. The major part of the petroleum-derived syndets are based on sodium dodecylbenzene sulfonate produced from alkylation of benzene, usually with propylene tetramer. Popular phraseology for these products is alkyl aryl sulfonates because their structure has varied. The cyclic portion for a time was toluene but hygroscopicity dictated its abandonment. The side chain has been kerosine derived through keryl chloride but that process has no current significance in the U. S., although it is still in use aboad.

The percentage of the surfactant, usually called active agent, in commerically built syndets has decreased since 1944 from an average of nearly 40 percent to currently an average of just under 25 percent. The use of molecularly dehydrated phosphates previously referred to has permitted this with increase in efficiency as recognized by the public in multiplication of sales volume. No further decline in the percentage of active agent is to be expected from the present level.

What Are the Trends?—The trend in alkylates has been to much lower color, less odor, and that thing which is so frequently the result of increased production permitting continuous operation in the petroleum industry, lower cost. In the period when this was occuring the price of benzene approximately doubled. Benzene constitutes nearly one-third of the alkylate molecule. This demand for benzene to make alkylate has been one of the reasons why benzene has been essential from the petroleum industry to supplement the supply from the coal tar industry. As is already the case with toluene, it would not be surprising if in a few years petroleum became the primary source. It already provides more than 25 percent of the national requirements.

Aside from the alkylate referred to previously, the raw materials from the petroleum industry include alkyl phenols, alkylene oxides, and even for one product an aliphatic mercaptan. More than 25 million pounds of ethylene oxide and propylene oxide are used in syndets.

At least one sulfonator of alkylate has gone to continuous sulfonation with lower costs. Sulfonation with

liquid sulfur trioxide permitting greater efficiency and less sodium sulfate in the product has been realized. Specifically a surfactant with over 90 percent active agent can be produced. Aliphatic sulfonates reached a volume of nearly 30 million pounds of active agent in 1944 but have become negligible. Production of alkylate cannot be correlated with U. S. syndet production because of substantial sales for sulfonation abroad. Competition, as might be expected, is with Shell (Curacao), Montecatini, Kuhlmanns, and the sulfonated product of Monsanto (England) as well as many lesser factors.

Expansion of the syndet industry in the late 1940's was almost crippled by phosphate shortages. A net result of the changes of the past decade is the transfer of about one and a half billion pounds of annual production from an organic chemical industry, the soap industry, to inorganic chemical industries, primarily the phosphate, caustic soda, and sulfuric acid industries. Specifically the molecularly-dehydrated phosphates were relatively minor as to production a decade ago and will approach or pass a billion pounds in 1953. Of this over three quarters is tripolyphosphate. This production is essential to the marketing of the bulk of the syndets derived either from fat or petroleum both to lower cost and improve performance.

Outlook on Future Growth—The production of syndets can plausibly be predicted to approach three billion pounds by 1960. That would involve further invasion of the home laundry field but only negligible replacement of soap for cotton washing in the power laundry. It would involve substantial invasion of the toilet bar field by the three products now being test marketed or their more successful sucessors. It would involve some increase in miscellaneous uses of syndets. This may be by further increase in use of liquid syndets, primarily for hand dishwashing and general cleaning. It may be by further expansion of the market for solid nonionics, used in automatic dishwashers and in types of laundering equipment which do not perform well with a high suds blanket. This might be by machine washing of sidewalks at night as practiced in New York but not yet elsewhere. It might be by inroads on power laundering of fine fabrics. It could be by some of dozens of other small or potential uses. Some uses are already saturated, for example all important scouring powders contain syndets in place of soap.

Factors Affecting Future Growth—A volume of three billion pounds of syndets would give a ceiling at that time on domestic use of alkylate under 500 million pounds with a probable consumption of over half that. But there are some small clouds on that horizon. The progress of the syndet industry has so reduced the consumption of inedible tallow that the price has dropped below five cents a pound and enormous stocks have built up. The same thing is currently happening in England and may reasonably be expected to occur progressively in other countries. That in turn permits the production of tallow alcohols by hydrogenolysis or by sodium reduction at costs much lower than dodecyl alcohol from coconut oil.

Already one syndet producer uses substantial amounts of sulfated tallow alcohols in a leading product, and two other plants will be in operation before the end of 1953. That in Chicago is dominated by a soap company, the one in Baltimore is not. Tallow alcohols will not displace sulfated petroleum alkylates but that their use has definitely limited the expansion is indicated by current statistics. The preference of tallow alcohols to

WHEN THE writer in 1947, with production at the 250 million pound level, dared to predict a billion pound syndet market by 1950 there were many skeptics. It happened to be almost exact. Now the talk is of two-billion, three-billion, and even four-billion pound markets. The two-billion level may be passed in 1953 with sales of over 900 million pounds in the first half of the year, and surely will be exceeded in 1954.

those derived from coconut oil depends in part on the tax assesed on the latter since 1932. If it were removed the fat competition with petroleum would be further increased.

Lower cost tallow permits cutting of soap prices to give syndets heightened competition and a reasonable expectation of stable low prices of soap for the foreseeable future. This competition of soap and syndets is intercompany in the sense that the largest syndet manufacturers are also soap producers. There is some evidence that syndets are bought on performance rather than strictly on price.

One cannot consider syndets from petroleum without a corresponding consideration of glycerine. Saponification of triglyceride fats leads inevitably to the production of around one pound of glycerine per ten pounds of fat consumed. Recovery of this is in the range of 80-90 percent. If one assumed—probably correctly—that each pound of syndet means a half pound of soap not made, because of syndet use where soap would not have been used, then in 1953 the effect is to reduce glycerine supplies by about 30 million pounds. Accordingly the petroleum industry brought this requirement into reasonable balance by production at the rate of about 60 million pounds annually. The price evidence indicates that production is at least all the market will absorb.

Future Developments—A fracture in the writer's crystal ball limits the predictions as to future developments which can be made with certainty. There is little doubt that there will be increased production of benzene and propylene tetramer leading to alkylate, and of synthetic glycerine and alkylene oxides. The petroleum industry abroad has produced a secondary alcohol in large tonnage by cracking of scale wax. Sulfated it is not acceptable by U. S. standards. Improvements could occur that would make it or a modification a factor here. There is always the possibility that a long-chain primary alcohol from petroleum will come out of some research laboratory. The chain length must be closely controllable and branching must be strictly limited. Modest reduction in cost of alkylate could arise from solving the problem of hygroscopicity of sodium dodecyl toluene.

The tonnage of products sold by the petroleum industry in the syndet field will always be minor as compared with engine fuels and lubricants. But the price is correspondingly a multiple of that of those large gallonage products so that the dollar contribution to the industry is not negligible to the companies active in the syndet field.

Petrochemical Process Handbook

The role of petrochemicals in . . .

Synthetic Rubber

Since this industry is the largest single consumer of petrochemicals, look at its:

♦ Economics ♦ Markets ♦ New Developments

Clayton F. Ruebensaal, Naugatuck Chemical, Naugatuck, Conn.

IN THE FIELD of petrochemicals, the synthetic rubber industry represents not only one of the largest manufacturers of petrochemicals, but also one of the largest consumers. Into the finished synthetic product go almost one-fifth, on a tonnage basis, of all petrochemicals produced. Some of these petrochemicals used in making the finished product are butadiene, styrene, carbon black, acrylonitrile, isobutylene, and isoprene. Since this industry has had most of its growth in the last 15 years, it is interesting to note how this industry has grown and how it can be expected to grow in the future.

Synthetic rubbers were known on a laboratory scale as early as the 1870's and inferior types had been produced on a small but commercial scale by the Germans as early as 1912. Specialty synthetics had been developed in America in the early thirties and small plants were later erected to produce butyl rubber, other general purpose types, and oil resistant grades such as the Buna-N's (butadiene-acrylonitrile type).

The annual production of all types of synthetic rubbers in this country, however, was only a little more than 6000 long tons when we found ourselves, in 1941, cut off from 95 percent of our natural rubber sources. It was at that time that the need for establishing our independence from vulnerable natural rubber sources served as a stimulus to industry and government to produce a general purpose rubber in large volume in this country.

The whole-hearted cooperation of Reconstruction Finance Corporation, the rubber industry, the chemical industry, and the petroleum industry with complete pooling of patents and technology in the interest of common defense is outstanding in American history.

The government-sponsored synthetic rubber program initiated early in 1940 was not only unique as a development of unprecedented technical proportions. It was also an untried economic and political undertaking which was to see repercussive effects on a national and international scale into this the second decade following its inception.

Capacity of New Rubbers—By spring of 1943, the first of ten so-called standard plants for the production of Buna-S (GR-S), a butadiene-styrene copolymer type, was in operation. The nine standard plants remaining in the program, in combination with four other government-owned Buna-S plants built earlier by the big four rubber companies, today have a total productive capacity of 860,000 long tons of Buna-S. Butyl rubber (GR-I) capacity exists in two government plants for a total of 90,000 long tons. Buna-N rubbers are made by four rubber companies in private plants totaling 20,000 long tons capacity and Neoprene capacity in private plants operated by one producer is rated at 70,000 long tons. This total of 1,040,000 annual long tons of total synthetic rubber capacity in the U. S. and 460,000 long tons in other countries (90,000 Canada; 300,000 estimated for USSR; 10,000 West Germany; 60,000 other) brings the world capacity of synthetic rubbers to about 1,500,000 long tons. This synthetic potential added to the average natural rubber productive capacity of about 1,700,000 long tons can provide the world with 3,200,000 annual long tons of new rubber.

Economics of Synthetic Rubbers—Neoprene sold in the range of $1 per pound when introduced in the early 1930's. This was 12 to 45 times the cost of natural rubber which varied over a considerable range during this period, but despite this price discrepancy its usage continued to grow. Two large volume specialty synthetics, Buna-N and Neoprene, are today two to three times the cost of natural rubber and have continually expanded despite wide fluctuations in the price of natural rubber over the past few years. These facts clearly define the specialty rubber's almost complete independence of natural rubber pricing.

This is not the case with the general purpose Buna-S rubbers. The government price of Buna-S, fixed at close to operating costs, has controlled the price of natural rubber within relatively narrow limits as compared with fluctuations between $0.03 and $3 per pound previous to the introduction of general purpose synthetics. The only exception to this control existed from the start of the demands of the Korean War in 1950 until early in 1951 when the reactivated productive capacity of the synthetic rubber plants once again brought the total supply of new rubber in line with demands.

It is to be expected, therefore, that although price fluctuations will continue to be anticipated in the natural rubber market, they will move through a much smaller range because of the stabilizing effect of adequate synthetic supply.

Although demands on synthetic production will also be expected to vary, the minimum production requirements should exceed the government's present stipulated lower limit of 500,000 long tons annual capacity spelled out as a requirement in the disposal plan covering the sale of the existing synthetic facilities.

The availability of general purpose synthetics in this country has provided the $5.5 billion rubber industry with a raw material now technologically superior to the natural product in many applications. It has added to the wealth of the American public and industry billions of dollars in earnings and savings due to its stabilizing effect on natural rubber price, reduction of large natural rubber inventories and through the manufacture of goods which otherwise would never have been produced.

Approximately half of this $5.5 billion rubber industry market is made up of tire business, $1 billion in industrial rubber products and another quarter billion dollars

in footwear. Although the demands of these markets have varied greatly through the years, the total requirements for rubber in the past have not been varied appreciably as a function of rubber price.

This fact should assure that the demands for synthetic, dictated by the excess of total demand for new rubber over natural supply, should be kept above the minimum 500,000 annual long tons previously stated.

The exact future price of synthetics, of course, can not now be arrived at because of the large number of indeterminants, not the least of which is the disposal price to be arrived at for the plants. It appears quite logical, however, that the selling price of Buna-S produced privately will exceed the existing government figure for some period of time subsequent to disposal. Contributing reasons for this are taxes obligated to be paid by private industry and requirements for a fair return on the capital employed to operate these facilities.

Impact on Other Industries—The impetus given the petrochemical and synthetic resin industries by the synthetic rubber defense program can be appreciated only when it is pointed out that butadiene, a relatively obscure chemical before 1942, skyrocketed to close to 200,000 short tons by 1943 and its production tripled to 600,000 short tons the following year. Styrene, which had been produced only in small commercial quantities before 1942, jumped to about 50,000 short tons in 1943 and 130,000 short tons by 1944. Today this monomer consumes about 45 percent of the nation's benzene productive capacity of which 30 percent is derived from petroleum.

The large scale availability of these low cost, versatile monomers, and the polymerization know-how obtained from the synthetic rubber program aided tremendously in the expansion of closely allied products which have large existing markets and a continuing growth potential. Examples of these are the butadiene-styrene latex type paints and the polystyrene and styrene copolymer resins used for a wide variety of industrial applications and consumer goods. With the slow-up of synthetic rubber demands for styrene in 1946 and 1947, excess capacity was quickly absorbed in the plastics industry by styrene resins and to a smaller degree the polyester resins. Additional styrene was also consumed for the protective coating markets by styrene-phenol and styrenated alkyd resins.

Because of war shortages of butylenes, approximately 60 percent of the peak production of butadiene (1944) was produced from alcohol at a cost four times that of petroleum-based monomer. Subsequent increased supplies of butane and butylene feed stocks eliminated the need for alcohol-based butadiene necessitating no further demands on these facilities until pressed by Korean War demands.

Our present total national butadiene capacity is 850,000 short tons, 635,000 short tons of which is derived from petroleum sources. Approximately 15 percent of the total capacity is derived from butane feed stocks, 60 percent from butylenes and 25 percent from the non-competitive alcohol process. Because of potentially more favorable future pricing and greater availability of butanes, it may develop that more of our ever-increasing demand for butadiene monomer may be derived from this source.

In addition to uses of butadiene as a polymerizable material, new avenues for its application as a reactive diolefin in chemical manufacturing, e.g. nylon, anthroquinone, etc., also exist.

Future Outlook—Near Term—A look at the near term picture, i.e., the next five years, should see natural rubber remaining at about a constant supply level. The time required for new seedlings to mature combined with the uncertain politico-economic situation in Indonesia, deters the enlargement of natural rubber availability during this period. Any large increase during the next decade is also doubtful due to anticipated lower yields resulting from the high average age of the existing plantings. The increasing demand for total new rubber therefore must be met by synthetic output continually increasing throughout this period to a point where most of, or possibly even more than, the existing Buna-S capacity will be required. Appreciable expansions should also be realized for Buna-N and butyl because of their rapidly advancing end use of technology.

The adoption of synthetic rubbers may be further augmented by:

(a) New large volume applications, such as the possibility of rubber roads, and increased usage of synthetic latex.
(b) Improved properties developed by new petrochemical-derived co-monomers such as the acrylates, vinyl toluene and others.
(c) And blending with synthetic resins and other additives.

Existing examples of this latter trend are the lower cost oil and rosin extended rubbers being made in increasing quantities, the whole field of resin/rubber blends exemplified by the high styrene rubber/GR-S mixtures for the shoe industry, the phenolic resin/Buna-N rubber blends and the styrene-acrylonitrile resin/Buna-N rubber blends for the high impact plastics industry.

Future Outlook—Long Term—For the long term picture, the President's Materials Policy Commission report forecasts a faster growth of synthetic over that of natural rubber. The figure of 2,700,000 long tons was predicted for synthetic requirements in 1975 as compared with the estimate of 2,300,000 long tons of the natural product needed in that same year.

New Developments—Ingenious equipment changes, revised processing techniques, and new catalyst systems and polymerization vehicles will produce better synthetic rubbers at appreciably faster rates. Some early experimentation has shown a possibility also exists for producing rubbers at elevated polymerization temperatures which will approximate those desirable properties of cold rubbers which are manufactured in much higher cost equipment.

In addition to modifications of the existing types of petrochemical-derived synthetic rubbers, industry may look forward to many new elastomers based on petroleum sources which are capturing the interest of this country at present. Prominent among these are the extremely high tear strength and abrasion resistant isocyanate elastomers. They are prepared by polyesterification of the petroleum-derived chemicals, adipic acid and mixed glycols. The polyester is further reacted with any of a series of organic isocyanates and finally cross-linked or "vulcanized" with water or a glycol. Another of the outstanding new vulcanized elastomers having excellent weathering resistance and unusually excellent physical properties is the chlorosulfonated polymer of ethylene.

One of the greatest incentives toward realization of this predicted diversification and growth of the synthetic rubber industry will be the disposal of the existing government-owned rubber producing facilities to private industry.

The additional forecast of continuing modifications and change from our existing polymer types, know-how and equipment presents a real challenge to our respective petroleum, chemical and rubber industries. It is a challenge, however, that they look forward to with confidence, enterprise and aggressiveness matching that demonstrated possible in the inception of the synthetic rubber program.

Petrochemical Process Handbook

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Fertilizers

The production of synthetic nitrogen from natural gas is expected to top 2 million short tons by 1955.

George Wash, Phillips Chemical Company, Bartlesville, Okla.

THE LARGEST quantity of nitrogen for fertilizers is made synthetically by atmospheric fixation. Some nitrogen is available in the United States from imported, mined Chilean nitrate, some from by-product ammonia from coke ovens, and a little from natural organics. Currently synthetic nitrogen fixation constitutes approximately 90 percent of the total U. S. production, and soon about 75 percent of the synthetic nitrogen will be manufactured from natural gas as a basic raw material.

Synthetic Nitrogen Development—World War I was made possible, as far as Germany was concerned, by Fritz Haber's discovery of a method of synthesizing ammonia from atmospheric nitrogen. The first commercial plant to produce ammonia by the reaction of hydrogen and nitrogen was started in Germany in 1913. After World War I, starting in the mid twenties, the manufacture of synthetic ammonia by the Haber process was expanded rapidly in this country by using hydrogen from the coke water gas reaction or from electrolytic cells in the fixation process. Natural gas was first used as a source of hydrogen for the production of ammonia in an American plant in 1931. As late as 1940, less than 5 percent of U. S. synthetic ammonia was manufactured from natural gas, but by 1951 approximately 50 percent of the U. S. synthetic ammonia was produced from natural gas. The current figure is in the order of 60 percent and by 1955 the figure may approximate 75 percent, since several existing plants have been converted from coke to natural gas, and a major portion of the current expansion program, scheduled for completion in 1955, is based on natural gas.

World War II Expansion—During World War II, the synthetic nitrogen production capacity in the U. S. was expanded almost fourfold—to a new level of approximately one million short tons annually—principally through construction of numerous plants by the U. S. government to produce ammonia for munitions manufacture. By 1943, government requirements for ammonia for this purpose began to decline and some of the ammonia and its derivatives began to be directed to fertilizer use. Essentially all of the government-built ammonia facilities subsequently were sold or leased to private industry. Immediately after World War II, there was doubt that demand would require the productive capacity of all of the U. S. nitrogen plants. This doubt soon was dispelled and demand continued to exceed supply.

Expansion to Be Completed by 1955—In 1951 a nitrogen expansion program was inaugurated which ultimately provided for an increase in synthetic nitrogen production of some 1,300,000 short tons per year for completion by 1955. After completion of this expansion program, total U. S. nitrogen production should approximate three million short tons annually, of which about 2,765,000 short tons would be synthetic production. Of the synthetic production, about 75 percent or more than two million short tons, will be derived from natural gas. Thus today, synthetic ammonia from natural gas ranks among the top petrochemicals from a tonnage standpoint. Including net imports, the total nitrogen supply by 1955 is estimated to approximate 3,275,000 short tons, of which 2,185,000 short tons is scheduled for agricultural use, 600,000 short tons for industrial use, and the balance for military use, exports, and miscellaneous uses. The 2,185,000 short ton supply for agriculture compares to about 450,000 short tons in 1940-41 and about 1,425,000 short tons consumed in 1951-52, the last year for which official figures currently are available, and an estimated 1,600,000 short ton supply (and consumption) in 1952-53.

Conservative estimates place U. S. synthetic nitrogen requirements at more than five million short tons annually by 1975.

Synthetic Ammonia and Derivatives for Fertilizer—Synthetic ammonia and its derivatives are the backbone of the U. S. fertilizer nitrogen industry. Ammonia, which contains 82 percent nitrogen, is the basic product in the nitrogen fixation process and it may be used as such for agricultural and industrial purposes or may be converted to other useful products, such as ammonium nitrate (33 percent nitrogen), ammonium sulfate (21 percent nitrogen), nitrogen solutions (about 40 percent nitrogen), urea (45 percent nitrogen), etc.

Ammonia, and particularly ammonium nitrate, are war-born products for munitions and explosive manufacture. By 1933, there were 10 small U. S. plants producing ammonium nitrate, by 1939 there were 16, and by 1945 there were 28, exclusive of government erected plants. These plants produced ammonium nitrate in relatively small quantities, principally for captive use in the manufacture of dynamite and other industrial type explosives. World War II brought about a terrific expansion in ammonium nitrate production capacity in the U. S. In the last half of 1942, a small amount of essentially pure ammonium nitrate was used as a fertilizer material in the U. S. and thereafter the use spread rapidly as the government requirements for munitions declined. Because of the hygroscopic nature of ammonium nitrate, it was necessary to develop a coating process and moisture proof bags to prevent caking of the product. Such process was developed successfully first for grained ammonium nitrate and subsequently for prilled ammonium nitrate. By 1949-50, ammonium nitrate used for fertilizer approximated 578,000 short tons per year. In 1951-52 it approximated 800,000 short tons. It appears that supply, and consequently consumption, soon will exceed one million short tons annually.

By-product coke oven ammonium sulfate long has been available in the U. S., principally for use in the manufac-

ture of mixed fertilizers. Production has ranged from 700,000 to 900,000 short tons per year during the last 20 or 25 years. Soon after World War II, especially starting in 1949, large quantities of synthetic ammonium sulfate were manufactured in the U. S. from synthetic ammonia and sulfuric acid. At that time, a large portion of the production was exported to Germany, Japan, Korea, etc., under government sponsored program. During 1950, 1,138,000 short tons of synthetic ammonium sulfate were produced, but since that time production has declined. This additional supply of ammonium sulfate has increased its use as direct application fertilizer material and its use in mixed fertilizer manufacture.

Nitrogen solutions, containing ammonia, ammonium nitrate and water, are a relatively new development in the U. S. with commerical production having started in 1933. Current supply of such solutions, containing approximately 40 percent nitrogen, approximates 300,000 short tons per year, equivalent to 320,000 short tons of nitrogen. These solutions are used for ammoniation of superphosphates in the manufacture of mixed fertilizers.

Anhydrous ammonia for application to the soil, directly or through irrigation water, is a relatively new development in the U. S. In 1934, ammonia was introduced into irrigation water in California. Soil injection was established in California on a commercial scale in 1943, and by 1947 the soil injection had migrated to the Mississippi Delta. Since that time, ammonia application has grown by leaps and bounds throughout the U. S. and those associated with the industry are wondering where the ceiling will be. Expressed in terms of short tons of nitrogen content, the use of anhydrous ammonia for direct application amounted to about 43,000 tons in 1947-48, jumped to around 120,000 tons in 1950-51, and is estimated to be in the order of 255,000 tons for the 1952-53 fertilizer year, ended June 30, 1953. A 300,000 short ton annual figure appears to be close at hand.

Outlook for Synthetic Nitrogen—Assuming that a reasonably high level of economy is maintained in the U. S., a future market outlook for all fertilizer materials, particularly for synthetic nitrogen derivatives, appears excellent. The demand and use of anhydrous ammonia for direct application has increased at a remarkable rate since initiation in the early 40's and its future use could increase at an even greater rate on a tonnage basis. Ammonium nitrate became available in large quantities for agricultural use only since World War II, and in the interim demand has always exceeded supply. Although quite a large increase in supply is scheduled, it appears that demand will continue to exceed supply.

Ammonium sulfate use is continuing to expand in the U. S., both for direct application and for mixed fertilizer manufacture. Currently, export demands are not so great for ammonium sulfate as they were during the last few years and European imports into the U. S. are becoming increasingly larger. Nevertheless, it appears likely that ammonium sulfate use will increase gradually during the next few years as the fertilizer industry grows. Nitrogen solutions supply is being increased to permit growth of the mixed fertilizer industry. Their future market outlook appears good for the foreseeable future.

Some New Developments—Petroleum derived sulfur plays an important part in the fertilizer picture. The fertilizer industry in the U. S. is by far the largest consumer of sulfuric acid. When the sulfur shortage developed in late 1950, and threatened fertilizer production, many new plans were built for the production of sulfur from waste hydrogen sulfide from natural gas and refinery waste gases. Such plants greatly aided the sulfur supply situation and are likely to continue to make an important contribution to the fertilizer industry.

Some of the newer products in the fertilizer nitrogen field are ammoniated phosphates, urea and nitrophosphates. The ammoniated phosphates, such as 16-20-0, 11-48-0, and combinations in between, represent products of good physical quality and of high plant food content. Demand for these products is likely to require appreciably increased supply during the next several years. Their increased availability is likely to speed up the trend to higher analysis mixed fertilizers.

The sulfur shortage, which developed in late 1950 and continued for approximately two years, caused great emphasis to be placed on the manufacture of so-called nitrophosphates. Production of such materials basically involves at least partial substitution of sulfuric acid with nitric acid. At least one major company is adapting this general process to the production of a 12-12-12 mixed fertilizer.

Urea, which can be produced from ammonia and CO_2, is not a new development, but its large scale production for fertilizer use here in the U. S. is a new development. Until quite recently, only one U. S. plant was producing appreciable quantities of urea for agricultural use and currently there are only two such plants in operation. Under the nitrogen expansion program, several new plants are scheduled for production of urea by 1955.

Summary—In summary, the entire fertilizer industry in the U. S. has undergone a terrific expansion in recent years as indicated by the following data:

Domestic Consumption of Primary Plant Nutrients
(In short tons)

	Nitrogen (N)	Available Phosphoric Oxide (P_2O_5)	Potash (K_2O)	Total
1900 Calendar Year	62,000	246,000	86,000	394,000
1910 Calendar Year	146,000	499,000	211,000	856,000
1920 Calendar Year	228,000	660,000	258,000	1,146,000
1930 Calendar Year	377,000	793,000	354,000	1,524,000
1940 Calendar Year	419,000	912,000	435,000	1,766,000
1950 Calendar Year	1,126,000	2,071,000	1,215,000	4,412,000
1951-52 Fertilizer Year	1,425,000	2,200,000	1,581,000	5,206,000
1955 Est. Supply (DPA Goal)	2,185,000	3,485,000	2,185,000	7,855,000
1960 Author's Estimate	3,000,000	.....	.....	.....
1975 Author's Estimate	5,000,000	.....	.....	.....

Assuming maintenance of a reasonably high level of economy in the U. S., it is likely that fertilizer use will continue to increase appreciably for an indefinite period. Population is increasing steadily while the tillable land acreage is stationary. This situation would indicate a need for greater production per acre, and as the soil becomes further depleted of available plant nutrients, it will be essential that more plant foods be added through the increased use of commerical fertilizers.

Although the total tons of plant food nutrients used in the U. S. are great, the quantities per acre are still quite small compared with many other countries where farming has become more intensified. It is only reasonable to assume that many factors point to increased plant food requirements in the U. S. in the years ahead. The new developments and products currently known are not likely to make any drastic change in the industry other than to lead to the production of higher analysis raw materials and mixed goods, and to stimulate increased demands for the products. The fertilizer industry may have its ups and downs, but the long range outlook appears good.

Petrochemical Process Handbook

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Synthetic Fibers

Over 260 million pounds of synthetic fibers were produced by this industry in 1952. Its growth means an expansion of petrochemical production.

Frank J. Soday, The Chemstrand Corporation, Decatur, Ala.

THE SPECTACULAR growth of synthetic fibers in recent years is of outstanding interest to the chemical industry, as they are made from chemicals which have only become available in commercial quantities and reasonable prices in recent years. With few exceptions, none could have been manufactured on a large scale 20 years ago. The required chemicals are largely of petrochemical origin, and the provision of chemicals for synthetic fiber manufacture promises to become one of the most important branches of this industry.

Rayon and acetate, the first artificial (or semi-synthetic) fibers, are derived from cellulose in the form of cotton linters or refined wood fibers. Acetate is of interest to the petrochemical industry, as large quantities of acetic anhydride are used in its manufacture.

The first plant for the production of rayon in this country was constructed at Marcus Hook in 1911, and is still being operated by the American Viscose Corporation. By 1930, rayon accounted for approximately 5% of the textile fibers sold in this country, and by 1938 rayon passed wool and was second only to cotton in terms of annual consumption.

TABLE 1

FIBER	Price per Pound	Principal Raw Material
Rayon	$0.38	Cellulose, carbon disulfide, caustic soda, sulfuric acid.
Acetate	0.39	Cellulose, acetic anhydride, acetone.
Nylon	1.60	Benzene, cyclohexane, butadiene, furfural, sodium cyanide.
Acrilan	1.85	Acrylonitrile.
Orlon	1.90	Acrylonitrile.
Dynel	1.28	Acrylonitrile, vinyl chloride.
Dacron	1.90	Ethylene glycol, terephthalic acid.
Saran	0.90	Vinylidene chloride, vinyl chloride.

TABLE 2

FIBER	Millions of Pounds	Weight Percent Basis	Dollar Value Basis	Variation from 1951 (Weight Basis)
Cotton	4,479	71	49	— 9%
Rayon (and Acetate)	1,146	18	21	— 3%
Wool	468	7	20	— 6%
Synthetic	260	4	10	+17%
Silk	7	..	..	....
	6,360	100	100	....

TABLE 3

FIBER	Consumption in Millions of Pounds	
	1960	1975
Nylon	300	800
Acrylics	325	1,200
Dacron	150	1,000
Miscellaneous	200	1,000
	975	4,000

The U. S. production of rayon and acetate was 1,136 million pounds in 1952, while the consumption was 1,146 million pounds. The latter was equivalent to 18% of our total fiber requirements.

Nylon First True Synthetic Fiber—Nylon, the first of the true synthetic fibers, was developed by E. I. Du Pont de Nemours and Company and placed on the market in 1939. Quickly displacing silk in the manufacture of fine and luxurious garments, it is regarded by many textile experts as the outstanding fiber among all natural and synthetic fibers.

Despite every effort by Du Pont, who are now engaged in the eighth major expansion of nylon production facilities since the war, the supply of nylon has been insufficient to meet the demand, and whole fields of application have been neglected due to the impossibility of diverting any of the product from established outlets.

The basic raw materials which may be used for the production of nylon include cyclohexane, butadiene, and furfural. These are converted to adipic acid and hexamethylene diamine, which are then reacted and polymerized to form nylon polymer.

The intermediates required for Du Pont's nylon operations come from plants located at Orange, Texas; Victoria, Texas, and Niagara Falls. Spinning plants are located at Seaford, Del.; Martinsville, Va., and Chattanooga, Tenn.

The Chemstrand Corporation is constructing near Pensacola, Fla., the first completely integrated plant ever built in this country for the production of nylon. Allied Chemical and Dye Corporation is building a plant for the production of nylon 6, a nylon type fiber, at Bermuda Hundred, Va., and American Enka Corporation plans to build a plant for the manufacture of nylon 6 at Enka, N. C.

Encouraged by the warm reception accorded nylon, the textile industry has demanded additional new fabrics and styles to be developed. As a result large research and development programs were initiated by chemical and fiber companies to meet these demands. The fruits of these endeavors have been making the headlines for the past two years.

Petrochemicals Used in Synthetic Fibers—Two of these new fibers, Acrilan and Orlon, are spun from acrylonitrile polymers and copolymers, and are commonly referred to as acrylic fibers. Acrylonitrile is manufactured from ethylene oxide by American Cyanamid Company at Warners, N. J., and by Carbide and Carbon Chemical Company at South Charleston, W. Va. Monsanto Chemical Company obtains acrylonitrile from acetylene at Texas

City, and American Cyanamid Company is building a second acrylonitrile plant near New Orleans.

Dynel is spun from a copolymer of acrylonitrile and vinyl chloride.

Dacron is a polyester fiber derived from a polymer resulting from the reaction of terephthalic acid with ethylene glycol. A similar fiber is being produced in England under the name of Terylene.

Saran, a vinylidene chloride polymer having wide utilization in the plastics industry, is now being converted to both staple and continuous filament fibers by a number of companies, including Dow Chemical Company, Firestone Tire & Rubber Company, The Bolta Company, and National Plastic Company.

Acrilan is produced in staple form in the new Chemstrand plant at Decatur, Ala. The Du Pont plant for the production of both staple and continuous filament Orlon is located at Camden, S. C. Carbide and Carbon has a dynel plant at Charleston, W. Va., and is considering the construction of a larger plant in North Carolina. Dacron is produced in staple and continuous filament forms at the Du Pont plant at Kinston, N. C.

In addition to these commercial fibers, a number of other synthetic fibers are in various stages of development. Cyanamid (X-51), Tennessee Eastman Company (M-24), Industrial Rayon Corporation, B. F. Goodrich Chemical Company, and Allied Chemical are known to have acrylonitrile fibers in various stages of development, and polyester and polyamide fibers are being investigated by several companies.

The principal raw materials used in the production of the various semi-synthetic (rayon and acetate) and synthetic fibers are listed in Table 1 together with representative selling prices for average deniers and staple lengths.

With the exception of cellulose, caustic soda, sulfuric acid, and furfural, all of the raw materials listed may be obtained from petroleum or natural gas, and in many cases this is the only practical source.

The textile producing and processing industries now consume approximately 25% of all of the industrial chemicals produced in this country, and this proportion undoubtely will increase as more of our fiber requirements are obtained by the use of chemical raw materials.

Consumption Increasing Rapidly—The use of synthetic fibers is growing at a rapid rate, the 1952 consumption being 260 million pounds, equivalent to 4 percent of our total fiber requirements.

The 1952 consumption of all fibers in this country is shown in Table 2.

The President's Materials Policy committee recently published an estimate (see Table 3) of synthetic fiber production in this country for 1960 and 1975.

Although most textile technologists will regard the 1975 estimates as excessive, the production of synthetic fibers is expected to increase several fold between now and 1975.

Price Stability and Uniformity—An outstanding factor in the growing use of synthetic fibers is price stability. Wool, which was priced at $1.65 per pound in 1948, jumped to $4.00 shortly after the outbreak of the Korean War, dropped to $3.00 by the end of 1950, and is now selling for $1.75. Rayon, during the same period, fluctuated in price between the narrow limits of 36 to 40 cents per pound, and nylon was even more stable in price. Based on readily available chemical raw materials, the new synthetic fibers, such as the acrylic fibers, undoubtedly will be quite stable in price and will have a stabilizing influence on the price of other fibers. The stabilizing influence of synthetic rubber upon the price of natural rubber is an outstanding example of what can be accomplished in this direction.

Another advantage furthering the development of the new synthetic fibers is uniformity. Made under rigidly controlled operating conditions from raw materials of unvarying quality, they can be produced to meet the precise specifications required by the fabric and apparel industries. As further experience is gained in their production, it is expected that even more rigid specifications can be met.

Using the acrylics, the fastest growing fiber family, as an example, acrylonitrile is first manufactured from natural gas by a series of four reactions. The light straw-colored liquid is then shipped to the synthetic fiber plant, where it is polymerized to form a solid material composed of long thread-like molecules. The polymer then is dissolved in a suitable solvent, pumped through minute orifices, dried, crimped, cut, and baled.

A pound of Acrilan can be obtained from 125 cubic feet of natural gas (methane) and 500 cubic feet of air. Assuming a straight-through process, approximately 8 hours is required to convert the natural gas to Acrilan staple.

The capital investment required per annual pound of staple fiber production ranges from $1.00 to $1.50, while the corresponding investment for continuous filament production ranges from $2.00 to $2.50. It has been estimated that $40 million is required to place a new fiber on the market on a plant-scale operation basis, and $150 million is required to construct and operate a fiber plant for the production of 50 million pounds of fiber per year, including the cost of the auxiliary plants for producing the chemical raw materials.

Future Growth—Synthetic fibers are required in increasing quantities as natural fibers are approaching the upper limit of productivity due to increasing competition with food crops for available land. Cotton production, in particular, seems to be leveling off at 15 million bales per year. The production of domestic wool has been declining for the past decade, and is now 40 percent less than it was in 1942. As a result the major portion of our wool requirements must be imported. In 1952 we consumed 468 million pounds of wool, but produced only 120 million pounds. Thus, three out of every four pounds of wool consumed was produced in other countries.

The present consumption (1953) of the principal fibers in this country is at the rate of 39.6 pounds per capita (26.8 pounds of cotton, 9.2 pounds of man-made fibers, and 3.6 pounds of wool). As our population is increasing at the rate of 2¾ million per year, approximately 100 million pounds of additional fibers will be required each year to meet their textile requirements. Additional amounts undoubtedly will also be required to take care of increasing per capita consumption of fibers, which was 20 pounds in 1930, 30 pounds in 1940, and 40 pounds in 1950.

The synthetic and semi-synthetic fiber industries already have grown to large proportions. Total sales are in excess of one billion dollars, and plant investments have almost reached the same amount. Raw material purchases amount to $500 million per year, and the yearly payroll is in excess of $250 million. Exceeding all other branches of the chemical process industries in rapidity of growth, its growth potential for the next decade is almost unlimited. It has been freely predicted that the manufacture of synthetic fibers will become one of the South's most important industries.

Petrochemical Process Handbook

The role of petrochemicals in . . .

Plastics and Resins

Polyethylene production alone exceeded 125 million pounds last year.

Raymond B. Seymour, Atlas Mineral Products Company, Mertztown, Pa.

THE USE OF petrochemicals in the plastics and synthetic resins industry has increased enormously within the last few years. The present rate of production of the major petrochemical based plastics and resins, such as vinyl resins, styrene polymers and copolymers, and polyethylene is greater than one billion pounds.

In addition to the base materials, such as ethylene and propylene, many other petroleum derivatives are raw materials for the modern plastics industry. Thus the plastics industry is no longer completely dependent on natural plastics or coal tar products. Today's plastics and petrochemical industries are so intimately related that it is often almost impossible to consider them separately.

It may be predicted that the plastics industry of the future will be come even more dependent upon petroleum for its raw materials. Likewise, the petrochemical industry of the future will be one of the largest consumers of plastic materials.

These two statements may appear to be incongruous unless one recognizes that petroleum based plastics are much more resistant to the attack by petroleum solvents and petrochemicals than other materials. Cellulosic and coal tar base plastics are used occasionally but they are usually more expensive and generally less satisfactory than petroleum based plastics for application in the petroleum industry.

Plastics and Resins from Petrochemicals—The major petrochemical-based plastics and resins are styrene polymer and copolymers, polyethylene and vinyl resins. It has been estimated conservatively that while the present production of polyethylene is only approximately 125 million pounds a year, the production will be quadrupled before 1960. The present rate of production of polyethylene is greater than all the cellulosic plastics combined. By 1960, it will be greater than the present production of all phenolic, urea, melamine, and coumarone-indene resins.

Other plastics dependent, at least in part, on petroleum hydrocarbons are polyisobutylene, polyvinyl acetate, polytetrafluoroethylene, epoxy resins and polyethylene oxide. The wide variety of available petroleum plastics becomes apparent when one recognizes that their properties range from water soluble polyethylene oxide to polyethylene which has an extremely low water absorption of less than one tenth of one percent. Likewise, polytetrafluoroethylene has poor adhesive properties but excellent heat and chemical resistance while in contrast, epoxy resins have outstanding adhesion to a wide variety of surfaces and possess moderate resistance to heat and chemicals.

Use in Industry—It may be predicted that in the near future many pipe lines, storage vessels, exhaust systems and even structures in the petroleum industry will be produced from self-supporting or reinforced plastics. Polyethylene, styrene copolymer, polyester and rigid vinyl pipe possess adequate properties for transporting petroleum hydrocarbons, salt water and acid solutions.

Reinforced polyester plastic pipe will withstand higher temperature conditions than pipe made from other plastic materials. Rigid vinyl pipe will exhibit maximum resistance to acids and polyethylene pipe will possess greater flexibility and impact resistance than plastic pipe produced from other petroleum resins. Standards and specifications for thermoplastic pipe are being established by the Thermoplastic Pipe division of the Society of the Plastics Industry.

As a result of present experience, it may be predicted that many petroleum storage tanks will be constructed from reinforced polyester plastics in the future. Such tanks are completely resistant to petroleum hydrocarbons, salt water and other corrosives characteristic of the petroleum industry. These tanks do not require painting since they may be pigmented in any color throughout the entire structure.

Reinforced polyester tanks of standard design having capacities of 250, 500 and 750 barrels are now available. These structures consist of standard flanged staves and triangular sections for tops and bottoms. Since all tanks of this type have the same curvature, the increase in capacity from 250 to 500 and 750 barrels is accomplished by building double and triple decker units consisting of one bottom and one top each.

Laminated sections of translucent reinforced polyesters have shown considerable promise for use in roofing and sidings in the petroleum process industry. Standard specifications for reinforced polyester plastics are being established by the Reinforced Plastics division of the Society of the Plastics Industry.

Rigid polyvinyl chloride sheet plastics are now available commercially and suitable heat welding and forming techniques have been developed. It is now possible to design and construct almost any type of exhaust or duct system from rigid polyvinyl chloride. Rigid unplasticized polyvinyl chloride has outstanding resistance to corrosive salts, alkalies and acids and is not softened by hydrocarbon solvents. Specifications and standards for this type of material are being developed by the Thermoplastic Structures division of the Society of the Plastics Industry.

With exception of derivatives of natural occurring plastic materials, such as cellulose acetatebutyrate, ethyl cellulose and chlorinated rubber, plastics are usually synthethized from coal tar pitch or petroleum hydrocarbons. Fortunately, both major sources of plastics are in good supply. However, the petrochemical industry has certain basic advantages over the coal tar industry. There is reason to believe that these advantages will increase in favor of the petrochemical industry as new processes are developed and better materials of construction are available.

The role of petrochemicals in . . .

Pesticides

Here is a study of the possibilities of increased petrochemical use in this segment of the agricultural market.

Lea S. Hitchner, National Agricultural Chemicals Association, Washington, D. C.

THE AMERICAN farmer now treats his crops with chemicals from the time of planting through all of its growing stages, up to and including the harvest period.

Until recent years products from the petroleum industry used in agricultural practices were considerably limited, due to lack of knowledge of how they could be used to produce farm chemicals. Now, we know how many products arising from petroleum can be utilized in the manufacture of pesticides for the protection of the farmer's crop and as aids in preparing his crop for harvest. The value of petrochemicals in this particular field has only begun to be recognized, and further research is needed to fully utilize these versatile chemicals.

The pesticides industry at the present time is producing around one billion pounds of basic pesticidal chemicals annually. Of the total billion pounds, sulfur represents nearly 500 million pounds, and the chlorinated hydrocarbons represent somewhere near 300 million pounds production annually.

The size of the potential market for the petrochemical producers can be illustrated by the fact that about 30 percent of all farm chemicals produced can be derived from petrochemicals. This does not include about 75 million pounds of various oils used as dormant sprays for the control of insects and related forms on fruit crops.

Pesticides Produced from Petrochemicals—There is a whole family of insecticides which can be produced from petrochemicals but, until recent date, the basic chemicals from which this family of insecticides is produced could not compete with other sources. These insecticides are the chlorinated hydrocarbons including the commonly known DDT. Other members include: benzene hexachloride (BHC), chlordane, heptachlor, aldrin, dieldrin, methoxychlor and other analogues of DDT.

The long fingers of the petroleum industry reach into the preparation of some of the plant disease control chemicals. It is possible to use these materials to produce captan and carbamates—important materials used as surface protectants against plant diseases. Some of our hormone-like weed killers, such as 2,4,5-T, can also be produced from petrochemicals.

How These Chemicals Are Used—By far the bulk of the BHC, DDT, toxaphene, dieldrin and aldrin are used in the cotton growing regions to protect this crop from the cotton boll weevil. At the present time, the dithiocarbamates are used as protectants against plant diseases, and their use ranks second only to copper sulfate in the total quantity of fungicides used on growing crops. Captan, used for many of the same plant diseases, is a product recently introduced and which must be developed further before it will compete with the dithiocarbamates in total tonnage.

Not only are petrochemicals used in the production of these basic pesticidal chemicals, but there is a growing use of petroleum products to formulate these chemicals into a suitable form for the farmer's use. Prior to World War II, a great portion of insecticides used in agriculture were formulated as dusts, but when the organic pesticides were introduced, many of them were soluble in some petroleum fractions. This permitted marketing them as liquid concentrates. The trend toward liquid concentrates of pesticides is increasing steadily, and it is expected that more and more of these farm chemicals will be marketed in this form.

When Market Opened Up—When organic chemicals were discovered to have valuable properties to mitigate agricultural pests, a whole new field for the use of petrochemicals came into being. The opening up of this new application was first brought into usefulness about 1945. Of course, many products from the petroleum industry were used in various ways to protect farm crops from pests, but they were largely limited to the various fractions of the cracking process. Little effort was made to modify them chemically to fit a specific use in farm practice. All this has been changed with the changing practices that revolutionized insect control, plant disease control, and many other types of operations that the modern farmer has found to be extremely profitable for his business.

Future for This Market—The over-all picture of crop protectants and other pesticides is, at present, in a state of adjustment. This does not mean that there is a lack of real opportunity for progress based primarily on research. The fact remains, however, that the pesticides industry is now in the economic doldrums due to overproduction of some items during the past two years.

The greatest field for expansion appears to be in the field of weed and brush control and in the control of plant diseases. Developments in this phase of agricultural chemicals have lagged behind those for the control of insect pests. New products being used for weed and brush control in both cropland and in grasslands were introduced at a relatively later date than some of the more effective organic insecticides. From the standpoint of potential usage and for innovations, weed and brush control may offer the largest field for research activity which would result in the largest returns.

It should be kept in mind, however, that to register a product for sale in interstate commerce, sufficient data as to its efficacy and its effects on man, animals and on crops themselves must be obtained. This requires no small investment in research and development. It has been reliably estimated that $255,000 to $500,000 is the average amount required to ready a pesticide for the market.

Petrochemical Process Handbook . . .

Wulff Acetylene

THE FLUOR CORPORATION, LTD.

APPLICATION: A process for manufacturing acetylene.

CHARGE: Natural gas, ethane, or propane. The primary requirement is that the feed must be a vaporizable hydrocarbon.

PRODUCT: Acetylene of high purity.

DESCRIPTION: Acetylene is made by the cracking of natural gas, ethane, or propane. Multiple furnaces in parallel are used to provide continuous flow of "cracked gas." Each furnace alternates between a "heating" and a "cracking" step. At any given time a mixture of feed vapor and dilution steam flows to one-half of the total number of furnaces, while air and fuel gas for heating flow to the other furnaces. Each furnace is reversed approximately every 60 seconds.

Flue gas effluent from the heating step flows from the furnace to a blower and is exhausted to the atmosphere. Cracked gas effluent from the furnaces is cooled by direct contact with water to condense and scrub out tars (no carbon black is produced). It is then compressed to atmospheric pressure by the cracked gas blower, flows through a Cottrell precipitator for final cleanup, and is compressed to recovery-system pressure in the main compressors.

The recovery and purification section uses a high-boiling solvent (300-400 F.), such as acetonyl acetone or dimethyl formamide for absorption and separation of the acetylene. The compressed gas flows to the diacetylene absorber where it is contacted with a small stream of lean solvent to remove the bulk of the diacetylene contaminant and some of the other higher homologs of acetylene. Solvent from the bottom of the diacetylene absorber flows to the diacetylene stripper where these contaminants are stripped out with a small stream of residue gas, which in turn goes to the furnace as fuel. The stripped solvent returns to the lean solvent surge tank or directly to the solvent purification system.

The main gas stream flows from the diacetylene absorber to the acetylene absorber where it is contacted with a major portion of the lean solvent. Residue gas from this absorber is divided. Small portions of it are used for stripping in the diacetylene stripper and final stripper and then go to the furnaces for fuel. The major portion is scrubbed with water to recover vaporized solvent and flows to the main fuel-gas system where it is used as fuel for the furnaces, gas engines, or boilers.

Rich solvent from the acetylene absorber flows to the rich solvent stabilizer. In this column, which is reboiled and refluxed with a small stream of lean solvent, ethylene, carbon dioxide, methane, hydrogen and other constituents more volatile than acetylene are taken overhead. These are then recycled through the main compressors to the acetylene absorber where they are eventually rejected.

Rich solvent flows from the bottom of the rich solvent stabilizer to the acetylene stripper. In this column, which is reboiled and refluxed with a small stream of lean solvent, the acetylene product is taken overhead to storage, while methylacetylene and other less volatile constituents, including the balance of higher homologs of acetylene, are retained in the bottoms. This solvent stream then flows to the final stripper where these higher homologs of acetylene are removed by stripping with residue gas.

In the course of heating acetylene solutions and its homologs, a small fraction polymerizes to a tarry material. To remove this polymer from the solvent, a small slipstream of the lean solvent is withdrawn from the solvent surge tank, diluted with water, and then sent to the polymer decanter where the polymer, now present as a separate phase, settles out and is withdrawn. The aqueous solution then joins the bottoms from the fuel gas scrubber and flows to the solvent rectifier, where water is removed by distillation. The purified solvent is returned to the system.

In certain applications where feed has an unusually high value, the raw-feed requirements and the net production of residue gas to fuel may be minimized by recycling a portion of the residue gas along with the fresh feed to the furnace. This achieves a higher yield of acetylene for each unit of feed at the expense of larger equipment for the plant. For such a "recycle" operation, the recycle stream is made up of the gas from the diacetylene stripper and the final stripper.

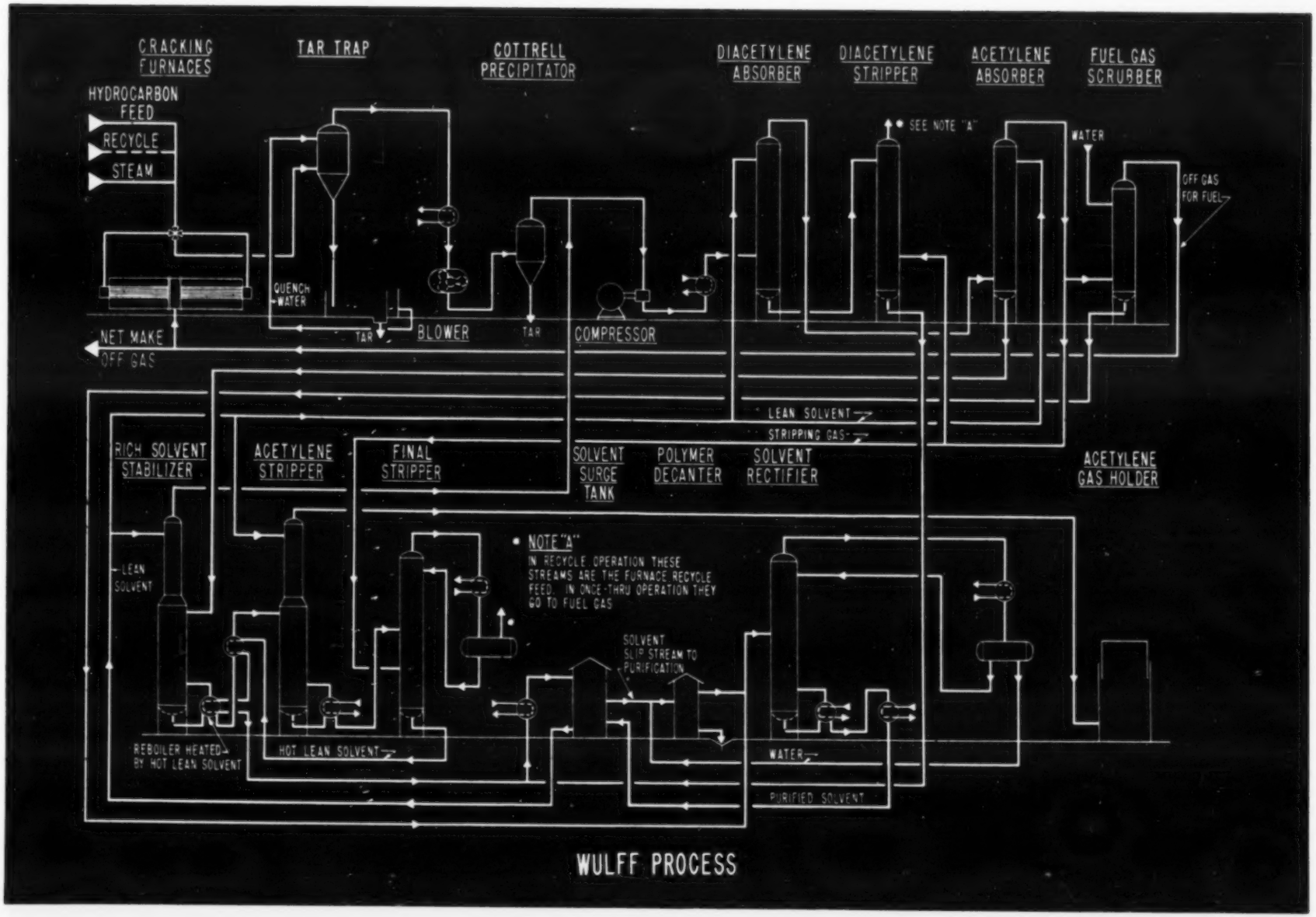
OPERATING CONDITIONS: The three major operating variables are temperature, residence time in furnace, and pressure. The operating temperature reaches a peak of 2200-2500 F. with the pressure at 15 inches of Hg absolute. The total time the gases are in the furnace is in in the order of 0.1 second.

YIELDS: Typical yields when operating on the various types of feed are shown in the table below:

	FEED MATERIAL		
	Natural Gas	Ethane	Propane
Percent feed converted to acetylene*	21.8	48.6	38.4
Lbs. acetylene recovered per 100 lb. feed	16.2	37.9	30.7

* Conversion is percent of carbon in feed which appears as carbon in furnace effluent acetylene.

COMMERCIAL INSTALLATIONS: A small commercial demonstration plant has been in operation at Maywood, Calif. by Wulff Process Co. since 1951.



WULFF PROCESS

Sachsse Acetylene

APPLICATION: A process for making acetylene.

CHARGE: Natural gas containing 90-95 percent methane; oxygen, 90-95 percent purity.

PRODUCT: Acetylene of 99 percent purity.

DESCRIPTION: Oxygen and natural gas are preheated separately in direct-fired heaters to about 950 F. The charge gases are mixed in a molar ratio of 0.65:1.00 oxygen:methane upon being fed to the converter. The converter is a vertical cylindrical unit comprising three sections: mixing chamber, flame room, and quench chamber. The mixing chamber is specially designed to provide rapid yet thorough mixing of oxygen and methane.

The mixed gases are fed through a plurality of ports to the flame room. Careful control is necessary to prevent backtravel or blowoff. In the flame, methane is cracked according to the endothermic reaction:

$$2CH_4 \rightarrow C_2H_2 + 3H_2$$

The exothermic combustion of methane supplies sensible and cracking heats. About one-third of the entering methane is cracked; most of the remainder is burned. Over all conversion of methane is 90-95 percent; conversion of oxygen is complete. The flame reaches an average temperature of 2700 F. Operating pressure is slightly above atmospheric. Residence time is 0.001-0.01 seconds.

The acetylene is cooled rapidly by a series of sprays located in the lower part of the converter. The cooled gases pass directly to a spray chamber where most of the water is condensed. The gases leave the chamber at 100 F. and have the following typical composition (dry basis):

Acetylene	8.5 percent
Hydrogen	56.0 percent
Carbon monoxide	25.0 percent
Carbon dioxide	3.5 percent
Methane	6.5 percent
Higher Acetylenes	0.5 percent
Total	100.0 percent

Before the cracked gas can be compressed and separated, residual soot must be removed. The clean cracked gas is then compressed to the head pressure (150 psig) of the concentration system.

The cracked gas is first scrubbed with a paraffinic oil to remove the very dangerous higher acetylenes. Any acetylene also removed is recovered in a pre-stripping operation. The cracked gas passes from the oil scrubber to the main absorber, where acetylene is removed by a selective solvent such as dimethyl formamide. This material shows a high acetylene: carbon dioxide selectivity, and therefore only a flashing operation is required to remove residual CO_2 from the rich solvent. Acetylene is ultimately stripped from the solvent in a conventional fractionator operating under reduced pressure. The product acetylene has a purity of 99 percent with major impurities being methylacetylene and carbon dioxide.

YIELDS: The over-all process yield of acetylene, based on carbon in the natural gas, is 30 percent.

COMMERCIAL INSTALLATIONS: This process or a variation is used by Carbide and Carbon Chemicals Company, Texas City, Texas; Monsanto Chemical Company, Texas City, Texas; American Cyanamide Company, Fortier, La. (under construction).

Formaldehyde and Acetaldehyde

APPLICATION: A process for manufacturing formaldehyde from methanol or acetaldehyde from ethanol.

CHARGE: Methanol, 99.8 percent purity and atmospheric air for formaldehyde production. Ethanol and atmospheric air for acetaldehyde production.

PRODUCT: Either formaldehyde, 37 weight percent aqueous solution or acetaldehyde, 99 percent purity is produced, depending on the charge.

DESCRIPTION:

Formaldehyde. Fresh and recycle methanol is vaporized, superheated and then passed to the methanol-air mixer. Atmospheric air is purified, compressed and then preheated to 130 F. in a finned exchanger.

Methanol and air are mixed in approximately equal volumetric proportions and are fed to the converter. The simultaneous reactions which occur are:

$$CH_3OH + 1/2\,O_2 \rightarrow HCHO + H_2O + 38\ \text{k-cal.}$$
$$CH_3OH \rightarrow HCHO + H_2 - 20\ \text{k-cal.}$$

The products emerge from the converter at about 1150 F. The converter is a small water-jacketed vessel which contains several layers of silver gauze catalyst. The operating pressure is 5-10 psig.

About 65 percent of the methanol is converted per pass. Oxygen conversion is essentially complete.

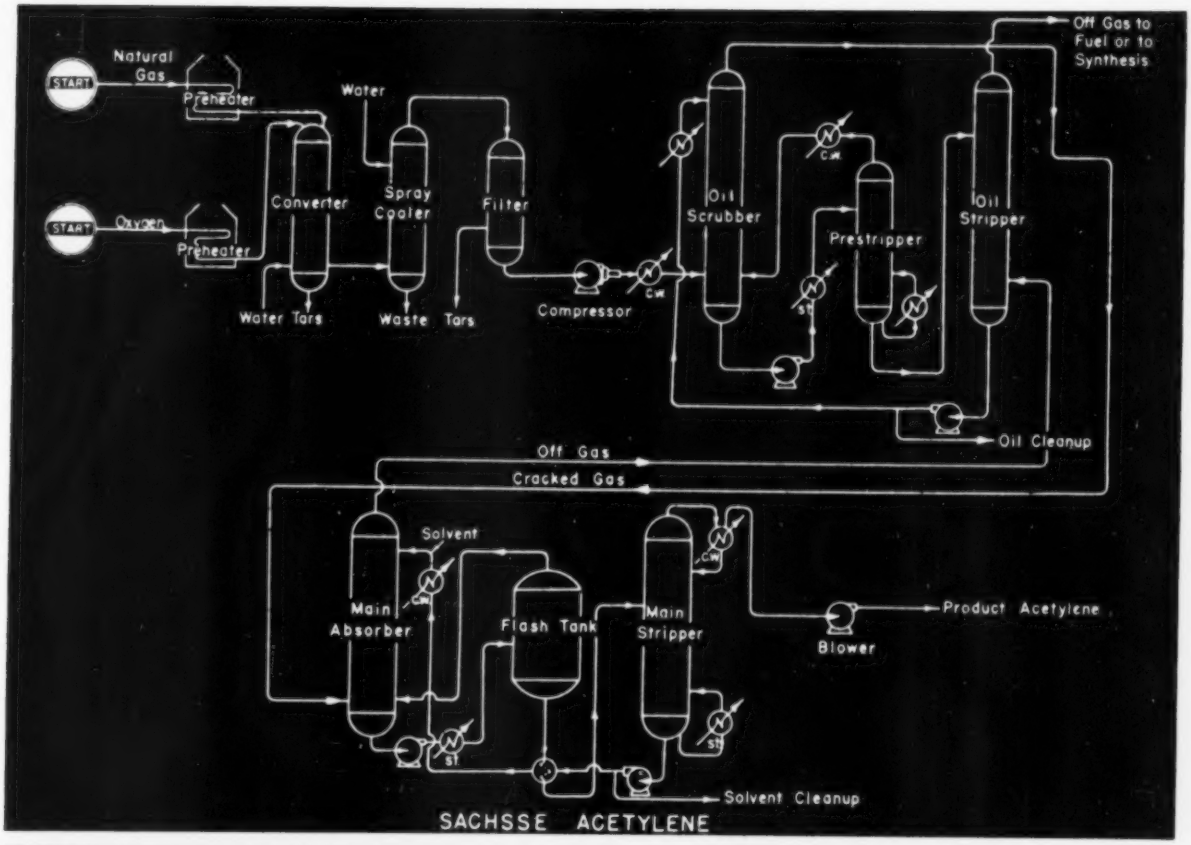
The reactor effluent containing about 25 percent formaldehyde is fed to two absorbers in series where cooling and separation occurs using a counter-current stream of methanol and formaldehyde. Rich solutions from both absorbers are combined and sent to the make tank.

The solution is pumped from the make tank to the methanol column where 99 percent methanol is separated overhead and recycled to the charge tank. The bottom stream from this tower is the product and contains from 1-7 percent methanol. Water is added to reduce formaldehyde concentration to 37 weight percent.

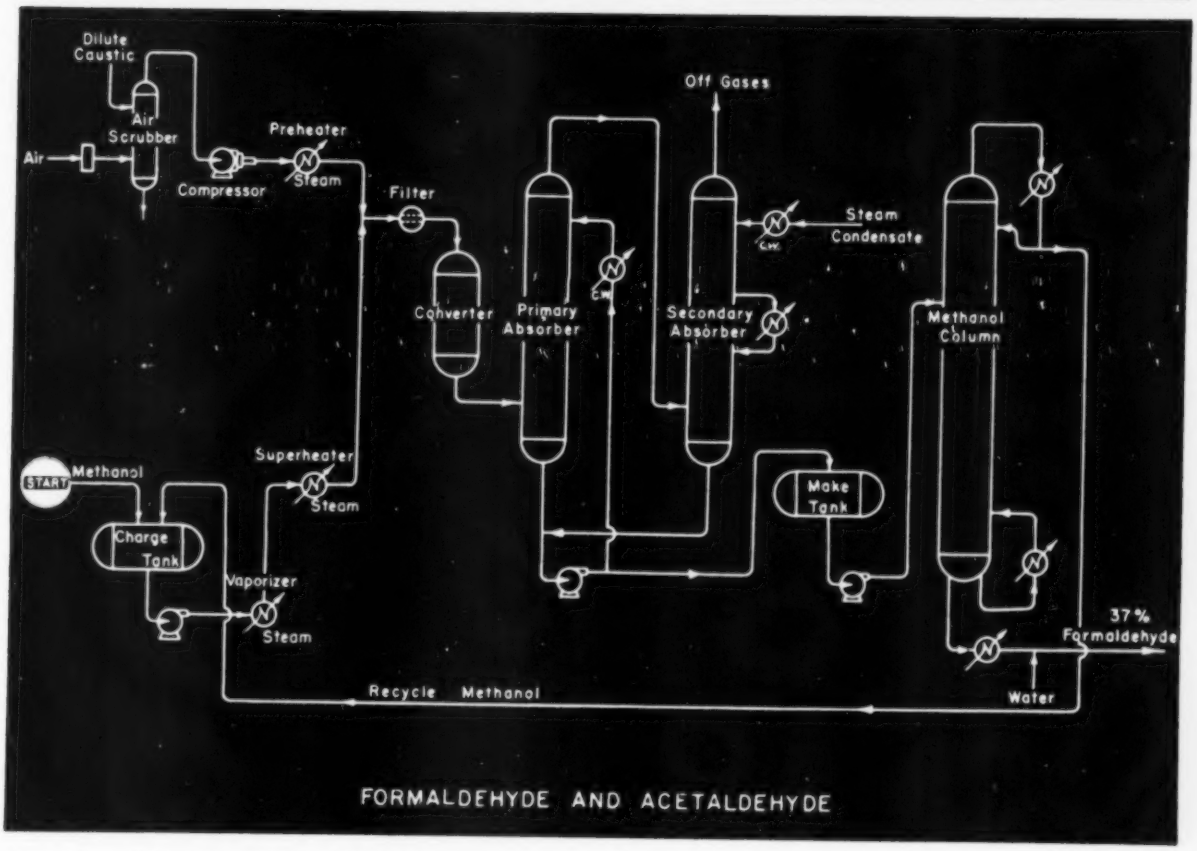
Acetaldehyde. Ethanol vapor at 320 F. is mixed with air preheated to 400 F. and passed over a silver gauze catalyst. Simultaneous oxidation-dehydrogenation takes place at 1000 F. to produce acetaldehyde with a yield of 85-90 percent. Conversion per pass of ethanol is about 50 percent. The reactor effluent passes to absorption towers in which alcohol and aldehyde are cooled and condensed by a countercurrent stream of dilute alcohol. The rich liquor is rectified in a series of two columns. In the first, 99 percent acetaldehyde is removed overhead. In the second, 95 percent alcohol is removed overhead and recycled to the reactor.

YIELDS: Over-all process yields of formaldehyde and acetaldehyde based on charge stock, are 85-90 and 85-95 percent, respectively.

COMMERCIAL INSTALLATIONS: This type of process or a variation is used at the following plants: Bakelite Corporation, Bound Brook, N. J.; Commercial Solvents Corporation, Agnew, Calif.; E. I. duPont de Nemours & Company, Perth Amboy, N. J. and Toledo, Ohio; Durez Plastics and Chemicals, Inc., North Tonawanda, N. Y.; Heyden Chemical Corporation, Garfield, N. J.; Monsanto Chemical Company, Springfield, Mass.; Rohm and Haas Company, Bristol, Pa.; Spencer Chemical Corporation, Calumet City, Ill.



SACHSSE ACETYLENE



FORMALDEHYDE AND ACETALDEHYDE

Methanol

THE VULCAN COPPER & SUPPLY COMPANY

APPLICATION: This process is applied to the manufacture of methanol.

CHARGE: Synthesis make-up gas (carbon monoxide and hydrogen) derived from natural gas, coal, by-product gases or oil is the charge.

PRODUCT: The product is high purity methanol.

DESCRIPTION: Synthesis make-up gas, supplied at a pressure of 5000 psig is passed through the iron carbonyl guard chamber for removal of iron carbonyl in the gas stream. Activated carbon is the absorbing reagent used. The synthesis make-up gas enters the synthesis system via an oil trap. Here, the compressed make-up gas joins the recycling gases of the synthesis system and traces of lubricating oil in the gases from the recirculator are removed. The collected oil is let down intermittently from the oil trap, as necessary, to an oil recovery system.

The combined gases, leaving the oil trap enter the converter at ambient temperature. In the converter, the active gas constituents, equivalent to the amount in the synthesis make-up gas, are converted to methanol, water and side-reaction products in vapor form, at approximately 640-680 F. However, due to internal heat exchange apparatus provided in the converter, the gases leave the converter at about 290 F.

The reactions involved are rather simple and are shown by the following equations:

$$CO + 2H_2 \rightarrow CH_3OH \quad (1)$$

$$CO_2 + 3H_2 \rightarrow CH_3OH + H_2O \quad (2)$$

The first reaction is preferred as it requires less hydrogen.

The effluent gases from the converter pass through the water-cooled primary condenser and the refrigerated secondary condenser where essentially 100 percent of the reaction products are condensed. The liquid product is separated from the gas stream in the methanol separator, the gases from the separator passing on to the suction of the recirculator which compresses the recycle gases sufficiently to overcome the system pressure drop and injects the recompressed gases into the oil trap.

Between the methanol separator and the recirculator a very small portion of the recycle gas stream may be vented to maintain the partial pressure of the non-reactive gases in the recycle gas stream at a reasonable level.

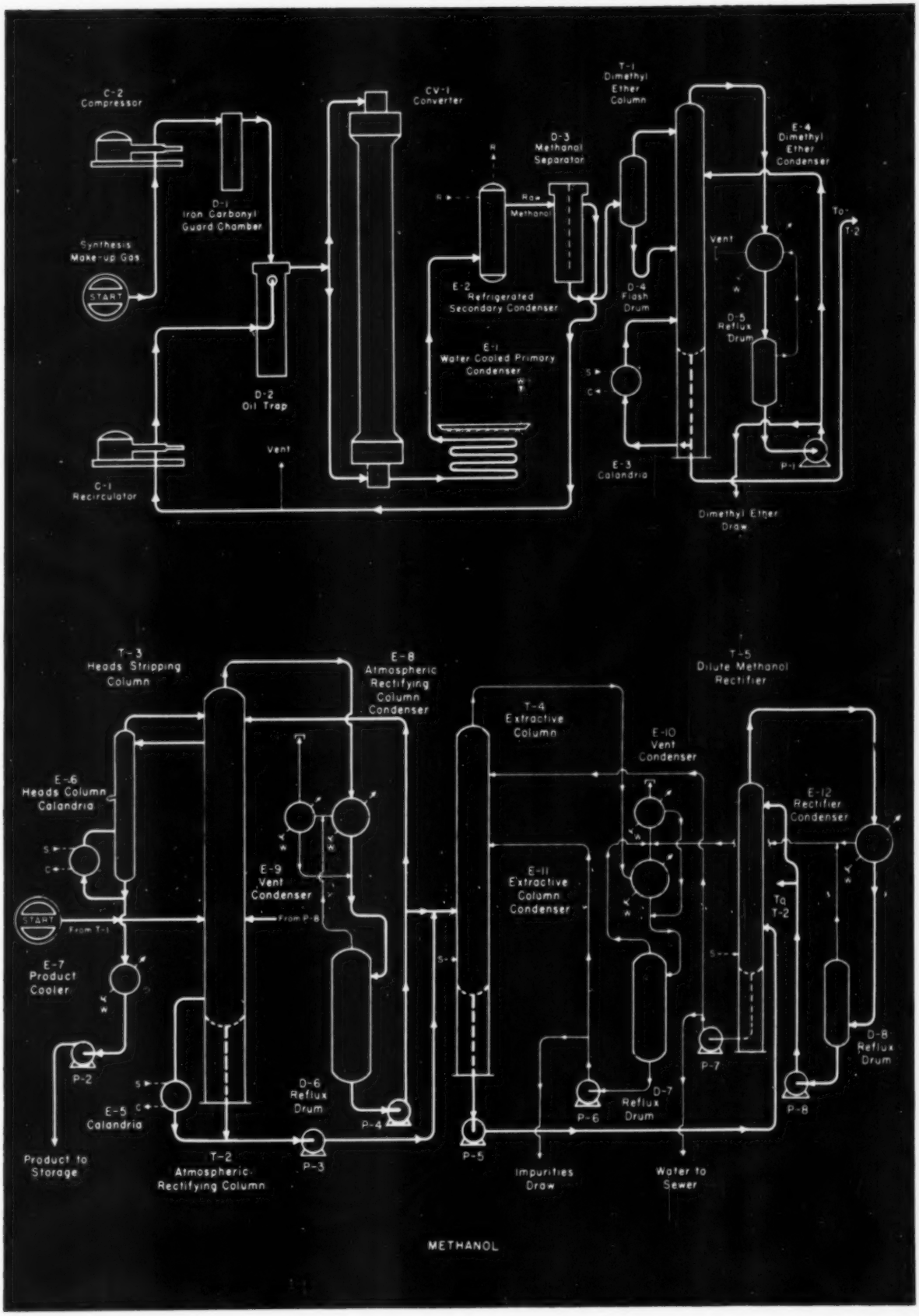
The raw methanol product, separated from the gases in the separator, is continuously let down to the low pressure flash drum where the bulk of the dissolved gases and low boiling compounds are vented due to the reduction in pressure. The condensate is fed into the dimethyl ether column, which operates under pressure, for removal and concentration of the remaining low boiling compounds. The steam-heated calandria supplies the necessary heat for the pressure stripping operation to remove the low boilers. The low boiling compounds are taken overhead and the water-cooled dimethyl condenser condenses the dimethyl ether, the non-condensables being vented from the system. The resultant dimethyl ether product is collected in the reflux drum. Part of the dimethyl ether product is returned to the dimethyl ether column as reflux and part is drawn off to dimethyl ether product storage.

Crude methanol is drawn off as bottoms from the dimethyl ether column and fed to the atmospheric rectifying column. Steam-heated calandria provide the necessary heat for rectification. A liquid methanol draw is taken near the top of the rectifying column and sent to the heads stripping column for final removal of traces of low boilers, the steam-heated heads column calandria providing the necessary heat for stripping the low boilers. Refined methanol is taken as bottoms product from the heads stripping column, cooled in the product cooler and transferred to finished product storage.

The low boilers, which are concentrated in the top of the rectifying column are taken overhead with an appreciable amount of methanol and are condensed in the atmospheric rectifying condenser and the vent condenser, the non-condensables being vented and the condensate collected in the reflux drum. Part of the condensate from the reflux drum is sent to the rectifying column as reflux, and part is sent to the extractive distillation column for recovery of methanol and concentration of impurities. Also, a bottoms fraction from the atmospheric rectifying column is transferred to the extractive distillation column for recovery of methanol and concentration of high boilers.

The extractive distillation column is heated by live steam injection and refluxed with water. Concentrated impurities are taken overhead and condensed in the extractive distillation column condenser and vent condenser, the non-condensables being vented from the system. The resultant condensate is collected in a reflux drum. Part of the condensate is recycled to the extractive distillation column and part is withdrawn from the system. Dilute methanol is withdrawn from the base of the extractive distillation column and transferred to the dilute methanol rectifier where concentrated methanol is taken overhead and condensed in the rectifier condenser. The concentrated methanol condensate is collected in the reflux drum. Part of the condensate is used as reflux and part is returned to the atmospheric rectifying column to recover the methanol content. Non-condensables are vented from the dilute rectifier condenser and the reflux drum through the vent condenser for recovery of trace quantities of methanol.

OPERATING CONDITIONS: The most important operating conditions are those in the reactor. The operating pressure in the reactor is about 4200 psig, and the temperature is 520-620 F.


C-2 Compressor
D-1 Iron Carbonyl Guard Chamber
Synthesis Make-up Gas
START
C-1 Recirculator
D-2 Oil Trap
Vent
CV-1 Converter
E-1 Water Cooled Primary Condenser
E-2 Refrigerated Secondary Condenser
D-3 Methanol Separator
Raw Methanol
T-1 Dimethyl Ether Column
D-4 Flash Drum
E-3 Calandria
E-4 Dimethyl Ether Condenser
Vent
D-5 Reflux Drum
To T-2
P-1
Dimethyl Ether Draw
T-3 Heads Stripping Column
E-6 Heads Column Calandria
E-7 Product Cooler
From T-1
From P-8
E-8 Atmospheric Rectifying Column Condenser
E-9 Vent Condenser
T-4 Extractive Column
E-10 Vent Condenser
E-11 Extractive Column Condenser
T-5 Dilute Methanol Rectifier
E-12 Rectifier Condenser
To T-2
D-8 Reflux Drum
P-2
E-5 Calandria
D-6 Reflux Drum
P-3
P-4
P-5
P-6
D-7 Reflux Drum
P-7
P-8
Product to Storage
T-2 Atmospheric Rectifying Column
Impurities Draw
Water to Sewer
METHANOL

Chlorinated Methanes

APPLICATION: This is a process for the manufacture of chlorinated methanes.

CHARGE: Methane, 99 percent purity, and chlorine, 99 percent purity are the charge.

PRODUCTS: Methyl chloride (CH_3Cl), 99 percent purity; methylene chloride (CH_2Cl_2), 88-92 percent purity; carbon tetrachloride (CCl_4), 99.5 percent purity; chloroform ($CHCl_3$), 99 percent purity are the products.

DESCRIPTION: The methane used in this process must be carefully refined to a purity of 99 percent or better. This is accomplished by selective absorption or by other conventional techniques. Impurities in the charge gas react selectively to reduce the yield of chloromethanes.

Chlorination may be effected by either photochemical or thermal means. In the representative case described below, the thermal technique is used for the primary chlorination and the photochemical technique is then used for the succeeding secondary chlorinations. It should be pointed out that slight variations in reactant ratio and operating conditions can alter the product distribution considerably. The chlorination reactions are strongly exothermic, and close control must be exercised to prevent degradation to products of carbon and hydrogen chloride.

Chlorine and methane (including recycle) are charged separately to the primary reactor in a molar ratio of 0.6:1.0. A temperature of 650-700 F. is maintained within the reactor, the reactants being preheated by the products. Chlorine conversion is essentially 100 percent. Methane conversion is about 65 percent. High velocities are maintained through narrow channels in order to prevent ignition. The operating pressure is slightly above atmospheric. The effluent gases include unreacted methane, traces of chlorine, hydrogen chloride, heavy chlorinated compounds, and chloromethanes in the following approximate ratio:

Methyl chloride	6.0
Methylene chloride	3.0
Chloroform	1.0
Carbon tetrachloride	0.25

The products are cooled in a tubular exchanger and are sent to the main absorber where chlorinated compounds are removed from methane and hydrogen chloride. The latter two materials comprise 75-80 percent of the reactor effluent. The solvent for the absorber is a refrigerated mixture of chloroform and carbon tetrachloride. The lean gas from the absorber, containing less than 3 percent chlorinated hydrocarbons, passes to a water-cooled karbate tower where it is scrubbed with dilute (less than 15 percent) hydrochloric acid. Thirty-two weight-percent acid is withdrawn from the bottom of the tower. The off gas is then scrubbed with caustic and dried with 98 percent sulfuric acid in separate towers. The resulting dry methane is recycled to the primary reactor by means of a blower.

The bottoms stream from the main absorber is preheated and sent to the main stripper where residual chlorine and hydrogen chloride, plus significant amounts of lower chlorinated materials are removed overhead. The off gas passes to a rubber- and brick-lined tower where hydrogen chloride is removed by scrubbing with 130 F. water. The tower is operated at elevated temperatures since the chlorinated materials have a dew point in the vicinity of 100 F. The lean gas contains 0.3-0.5 percent hydrogen chloride and is saturated with water. Neutralization and drying are accomplished by successive scrubbing with dilute caustic and 98 percent sulfuric acid.

The dry gas is compressed to about 110 psig and fed to the methyl chloride column. The overhead product contains 99 percent methyl chloride, meeting technical grade specifications. It is flammable and toxic, and requires special handling precautions.

A portion of the methylene chloride present in the methyl chloride tower bottoms is distilled overhead in a second fractionator. The methylene chloride product has a purity of 88-92 percent. The bottoms from this second fractionator are combined with the bottoms from the main stripper and charged to secondary reactor "A".

The secondary chlorinations are carried out in the liquid phase, using photochemical activation. Special reactors expose a maximum of liquid at close range to a mercury arc lamp. Fresh chlorine is introduced to convert methylene chloride to chloroform. The reactor operates at essentially ambient temperature, with the exothermic heat of reaction being removed by cooling coils and a reflux condenser. Hydrogen chloride escapes and is collected in scrubbing towers (not shown on the flow diagram).

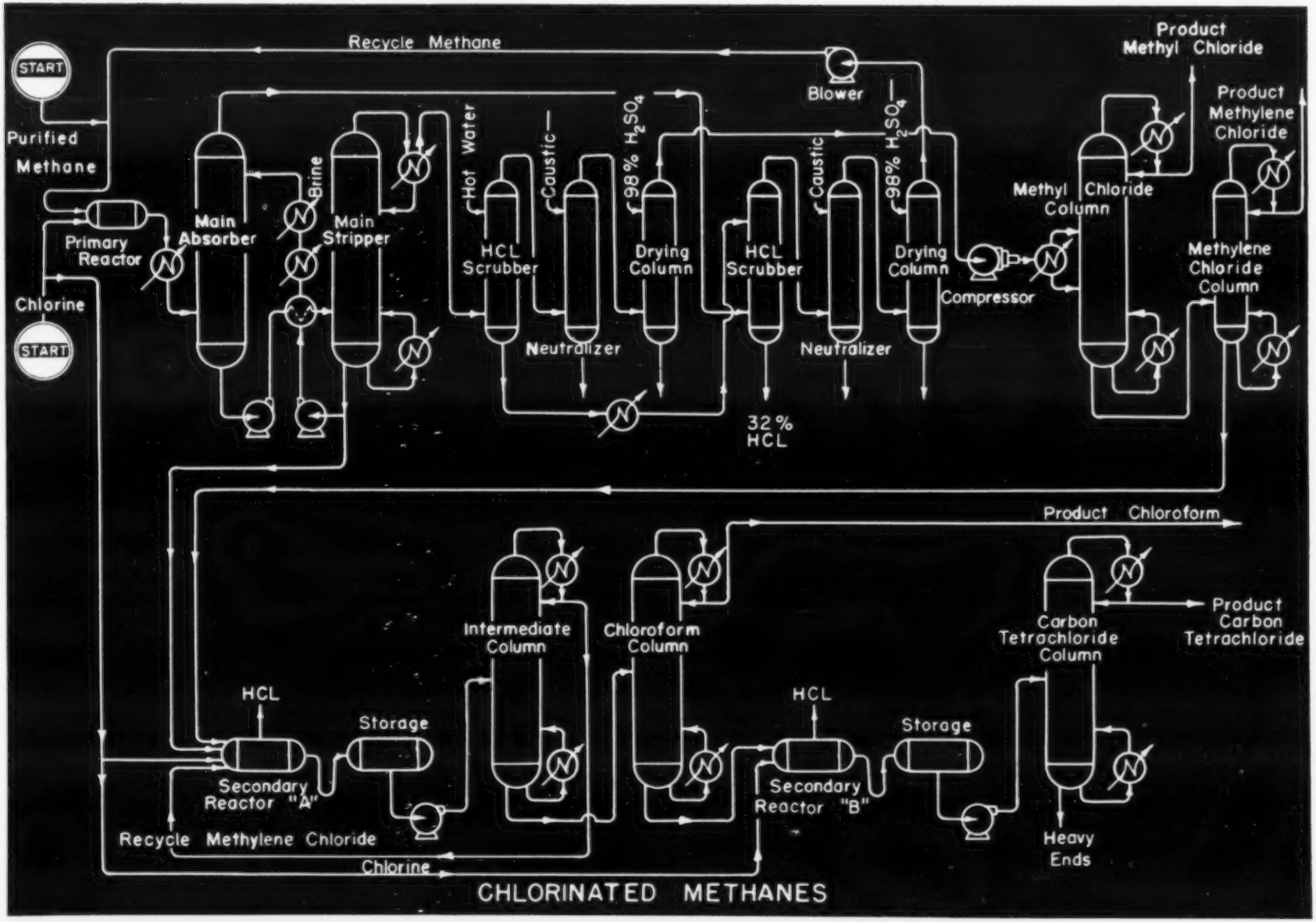
The overflow from the reactor goes to a storage tank and thence to the intermediate column, where unreacted methylene chloride is removed overhead and recycled to the reactor. U.S.P. Chloroform (99.0-99.5 weight percent) is taken overhead in the following fractionator. The bottoms stream from this second tower contains chloroform and lesser amounts of carbon tetrachloride and high boilers. It is mixed with fresh chlorine to form the charge for secondary reactor "B".

In this second photomechanical reactor chloroform is converted to carbon tetrachloride. The effluent passes to a fractionator where 99.5 percent carbon tetrachloride is removed overhead.

OPERATING CONDITIONS: Chlorination conditions vary with the product distribution desired, which in turn varies with market conditions. A representative set of operating conditions for the primary chlorination is included in the above text.

YIELDS: Over-all process yield, methane to chlorinated methanes is 85-90 percent.

COMMERCIAL INSTALLATIONS: This process or a variation is used at the Dow Chemical Company, Pittsburg, California, and Freeport, Texas.


START
Purified Methane
Chlorine
START
Primary Reactor
Main Absorber
Brine
Main Stripper
Recycle Methane
Blower
Hot Water
Caustic
98% H_2SO_4
HCL Scrubber
Neutralizer
Drying Column
32% HCL
Caustic
98% H_2SO_4
HCL Scrubber
Neutralizer
Drying Column
Compressor
Product Methyl Chloride
Methyl Chloride Column
Product Methylene Chloride
Methylene Chloride Column
Product Chloroform
Intermediate Column
Chloroform Column
Carbon Tetrachloride Column
Product Carbon Tetrachloride
HCL
Storage
Secondary Reactor "A"
Recycle Methylene Chloride
Chlorine
HCL
Storage
Secondary Reactor "B"
Heavy Ends
CHLORINATED METHANES

Ethyl Alcohol and Ethyl Ether

APPLICATION: The esterification-hydrolysis process for the manufacture of ethyl alcohol and ethyl ether.

CHARGE: Ethylene-rich gas (35-95 percent C_2H_4); concentrated sulfuric acid (98 percent strength).

PRODUCTS: Ethyl alcohol, 95 volume-percent purity; ethyl ether, 99 weight-percent purity.

DESCRIPTION: A plant designed to produce both ethyl alcohol and ethyl ether by esterification-hydrolysis is flexible with regard to the relative amounts of these materials produced. When operated primarily for alcohol, the by-product ether produced amounts to about 5-10 percent of the total production. When operated primarily for ether, little or no alcohol need be produced. Such flexibility has been included in the process to be described here. Because of the range of production conditions, compositions of intermediate streams must necessarily be omitted.

The initial processing step involves the reaction of ethylene with concentrated sulfuric acid to form a mixture of ethyl- and diethylsulfates. The size of the reactor varies inversely with acid concentration, ethylene content of the charge gas, and operating pressure. The most economic reactor size thus depends on the conditions of available gas and acid.

Ethylene-rich gas (35-95 percent C_2H_4) is contacted by concentrated sulfuric acid (usually 98 percent strength) in a conventional plate column. For operating pressures as low as 100 psig and for dilute gas, more than one tower may be required, as is shown on the flow diagram. Operating pressures as high as 500 psig are employed. Cooling coils are provided within the towers to maintain operating temperatures in the range 130-170 F. Inerts and saturated hydrocarbons in the charge gas pass through the towers unchanged and are discharged from the system through a tail gas scrubber which functions to remove entrained acid. Propylene and butylene in the charge gas react with the acid to form the corresponding sulfates.

The mixture of acid and sulfates flows from the bottom of the final absorber to the hydrolyzer where it is mixed with a measured amount of water. Hydrolysis takes place, producing alcohol and sulfuric acid. If the emphasis is on ether production, the residence time is increased and alcohol is recycled to the hydrolyzer. The resulting reactions are:

$$C_2H_5OH + C_2H_5HSO_4 \rightarrow C_2H_5OC_2H_5 + H_2SO_4$$

$$C_2H_5OH + (C_2H_5)_2SO_4 \rightarrow C_2H_5OC_2H_5 + C_2H_5HSO_4$$

For full ether production, residence times on the order of three hours and temperatures as high as 250 F are required. Live steam is utilized for heating the hydrolyzer contents. Operation is under pressure, slightly below that of the absorbers. The hydrolyzer is a lead-lined steel vessel containing an inner layer of acid-proof brick.

The hydrolyzate, containing ether, alcohol, acid, and minor contaminants, is pressured to the generator where ether, alcohol, and water are stripped with live steam. The generator is a ring-packed tower, lead- and brick-lined. In some cases the heat for vaporization is supplied indirectly in lead coils in order to avoid dilution of acid. The residual sulfuric acid from the generator has a strength of 50-60 percent; it is concentrated and fortified by conventional means before being returned to the absorbers.

The stripped vapors from the generator pass through a scrubbing tower where acid traces are removed by 8-10 percent caustic. The scrubber is fabricated from monel metal or some other material suitable to resist acid and alkali attack. The vapors from the scrubber are condensed in a tubular exchanger.

A small portion of fixed gases separates at the condenser and is scrubbed with water to recover alcohol and ether. These gases include ethylene which is regenerated in the hydrolysis and stripping operations. The combined solutions from condenser and scrubber are placed in crude storage prior to final separation and purification.

The crude alcohol and ether is pumped to the heads column where a sharp separation between ether and alcohol is made. Operation is slightly above atmospheric pressure. The ether and light ends passing overhead are condensed and then given successive washes by water and alkaline permanganate solution.

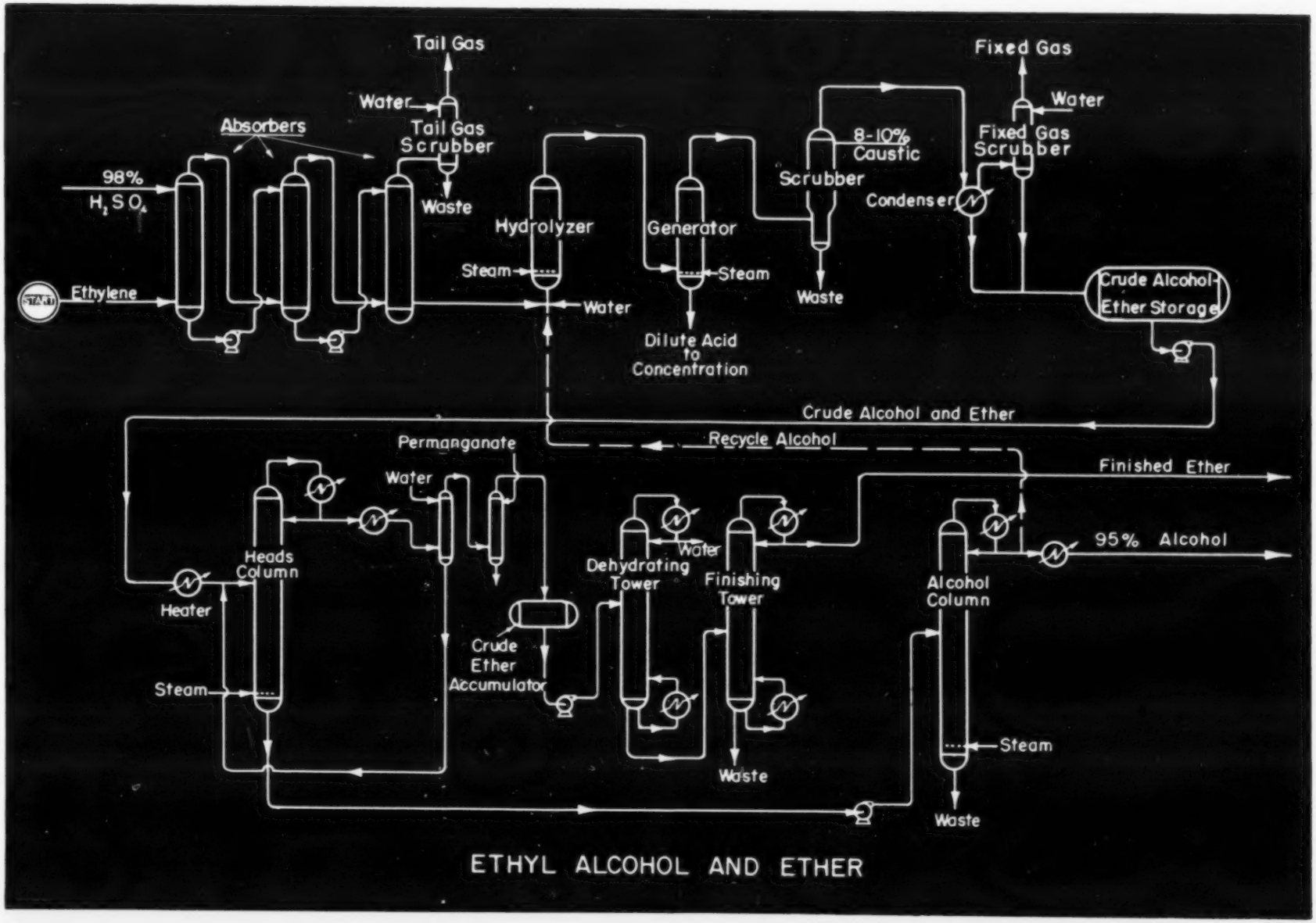
The ether is given final purification in two distillation columns. In the first column, which operates at 100 psig, water is entrained overhead and is separated as the lower layer from the reflux accumulator. In the second column, which operates at 50 psig, high boilers are removed from the dried ether. The refined ether is placed in pressure storage. It analyzes 99 weight-percent ether.

The bottoms stream from the heads column, containing alcohol, water, and heavy ends, is sent to the alcohol column where commercial ethyl alcohol is distilled overhead. This material is graded 190 proof and is sent to government-controlled storage before being denatured. A portion of the overhead stream from the alcohol column may be recycled to the hydrolyzer for ether production.

OPERATING CONDITIONS: These conditions vary according to the relative amounts of ether and alcohol produced. The ranges given in the above text are typical.

YIELDS: 90 percent over-all process yield, alcohol from ethylene.

COMMERCIAL INSTALLATIONS: This process of a variation is used at the following plants: Carbide and Carbon Chemicals Company, South Charleston, W. Va.; Texas City, Texas; Whiting, Ind. Esso Standard Oil Company, Baton Rouge, La.; Linden, N. J. National Petro-Chemicals Company, Tuscola, Ill.


Tail Gas
Water
Tail Gas Scrubber
Absorbers
98% H_2SO_4
Waste
Hydrolyzer
Generator
Steam
Steam
Water
Dilute Acid to Concentration
Scrubber
8-10% Caustic
Waste
Fixed Gas
Water
Fixed Gas Scrubber
Condenser
Crude Alcohol Ether Storage
START
Ethylene
Crude Alcohol and Ether
Recycle Alcohol
Permanganate
Water
Finished Ether
95% Alcohol
Heads Column
Heater
Steam
Crude Ether Accumulator
Dehydrating Tower
Water
Finishing Tower
Waste
Alcohol Column
Steam
Waste
ETHYL ALCOHOL AND ETHER

Extractive Distillation of Alcohols

STONE & WEBSTER-BADGER

APPLICATION: A process for recovery and purification of high purity alcohol.

CHARGE: Hydrocarbon oxidation products may be processed to recover essentially all of their alcohol content.

PRODUCT: High-grade industrial alcohols or neutral spirits meeting rigid chemical and organoleptic specifications.

INTRODUCTION: Ethyl alcohol was among the earliest organic compounds to be distilled commercially on a large scale, and much was learned about methods of design and purification. This resulted in a more or less standard unit based on the Barbet system for the production of neutral spirits. Alcohol produced from ethylene is relatively pure and may be refined in the same manner as that from fermentation. However, where the ethanol has been produced synthetically along with many other compounds, it is very difficult to obtain a high purity product. Extractive distillation, a method by which compounds that boil close together or form azeotropes can be efficiently separated, must be used. This permits the production of high-grade industrial solvents and neutral spirits from any source. When applied to relatively pure synthetic raw distillate, such as that resulting from the hydration of ethylene, it produces superior products suitable as solvents in the fine chemicals industry.

DESCRIPTION: Ethanol produced from ethylene by the sulfation and subsequent hydration (as shown in Figure 1) is relatively pure and may be finished in a conventional two-column system. The first column is the heads column where the low boilers are removed overhead. The second column is the alcohol rectifying column, from which the product is removed as a pasteurized cut near the top. The small quantity of high boilers present are allowed to build up in the rectifying column and are withdrawn as a sidestream near the feed plate.

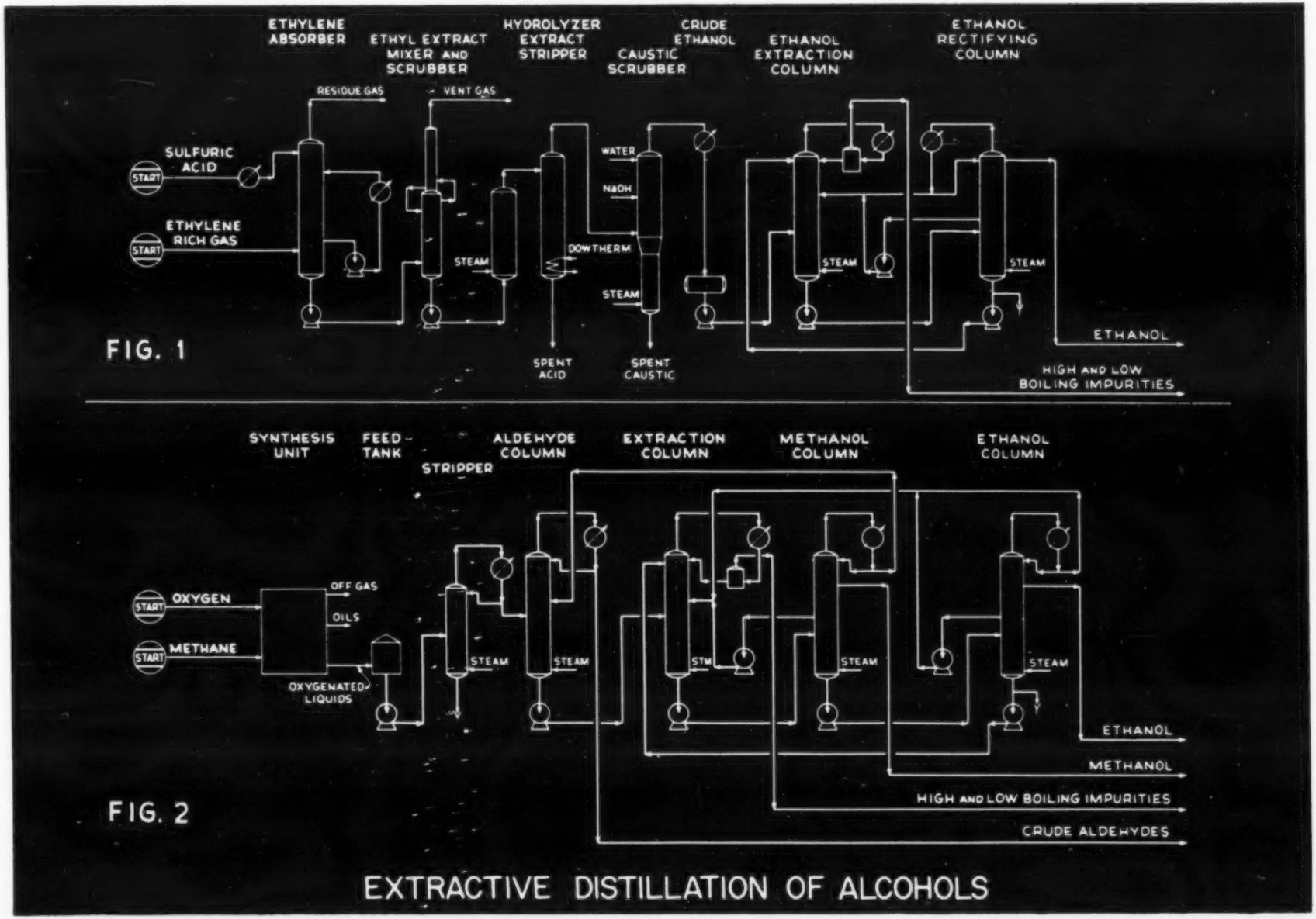
In Figure 1, the extractive distillation method is shown. Crude ethanol is fed into the mid-portion of the extraction column. Sufficient water is added to the top plate of the column to give a low proof bottoms and live steam is added to the base. As the vapor ascends the stripping section of the column, all of the volatile compounds tend to be stripped out of the descending low ethanol concentration liquid; however, at this low ethanol concentration, both the low and high boiling impurities have higher volatility and are preferentially removed upwards. The vapors above the feed plate are washed with large quantities of water, such that the more soluble ethanol is absorbed and returned to the stripping section, eventually flowing out the bottom. The overhead vapors, consisting essentially of impurities and water, are condensed and returned to the top plate as reflux. The impurities, substantially free of ethanol, are drawn off from this reflux stream as the overhead product from the column.

The dilute bottoms from the extraction column are fed to the rectifying column where the ethanol is withdrawn as a pasteurized product near the top. A heads cut from the top and a high boiler recycle stream near the feed plate are returned to the dilute zone of the extraction column above the feed point. Water, free of ethanol, flows from the base of the column and is recycled back as dilution water to the extraction column. Substantially all of the ethanol contained in the feed is recovered as high-grade neutral spirits of superior quality to those produced by a unit employing conventional heads and concentration columns.

Figure 2 illustrates a unit that will recover ethanol from a mixture of oxygenated compounds, which are present in processes of partial oxidation of light aliphatic hydrocarbons, either for the purpose of producing synthetic fuels or organic chemicals as such. A crude distillate of this nature must be processed by extractive distillation if complicated and expensive chemical treatment is to be avoided.

The water layer effluent from the reaction is first passed through a stripper to concentrate partially the chemicals and to remove acidic impurities. The acid-free feed is then fed to an aldehyde column for the removal of acetaldehyde and other low boiling impurities before entering the extraction column. If there is a considerable quantity of methanol present in relation to the ethanol, the two alcohols may be purified together and separated from each other after the extraction step in two separate columns, as indicated in Figure 2. However, if the amount of methanol is small in relation to the ethanol content, the aldehyde column may be operated to take methanol and lighter compounds overhead, and the methanol column can be eliminated. The operation of the extraction column is the same as in the system shown in Figure 1 and high quality methanol and ethanol are produced.

COMMERCIAL INSTALLATIONS: Numerous installations are in operation refining not only distillates from ethylene hydration and oil synthesis plants but also from fermentation processes.


ETHYLENE ABSORBER
ETHYL EXTRACT MIXER AND SCRUBBER
HYDROLYZER EXTRACT STRIPPER
CAUSTIC SCRUBBER
CRUDE ETHANOL
ETHANOL EXTRACTION COLUMN
ETHANOL RECTIFYING COLUMN
RESIDUE GAS
VENT GAS
SULFURIC ACID
START
ETHYLENE RICH GAS
START
WATER
NaOH
DOWTHERM
STEAM
STEAM
STEAM
STEAM
STEAM
SPENT ACID
SPENT CAUSTIC
ETHANOL
HIGH AND LOW BOILING IMPURITIES
FIG. 1
SYNTHESIS UNIT
FEED-TANK
STRIPPER
ALDEHYDE COLUMN
EXTRACTION COLUMN
METHANOL COLUMN
ETHANOL COLUMN
START
OXYGEN
START
METHANE
OFF GAS
OILS
OXYGENATED LIQUIDS
STEAM
STEAM
STM
STEAM
STEAM
ETHANOL
METHANOL
HIGH AND LOW BOILING IMPURITIES
CRUDE ALDEHYDES
FIG. 2
EXTRACTIVE DISTILLATION OF ALCOHOLS

Ethylene Production

STONE & WEBSTER-BADGER

APPLICATION: The process is applied to the recovery of ethylene from refinery gases and with ethane and propane cracking for additional ethylene production.

CHARGE: The charge for this process is refinery gas from cracking operations and/or light saturated hydrocarbons extracted from natural gas.

PRODUCTS: The primary product is high purity ethylene. Other products are:

(1) A residue gas, substantially hydrogen and methane.
(2) A liquid fraction which may be further fractionated.

DESCRIPTION: The recovery process utilized may be either low temperature fractionation or low temperature absorption, depending on the composition and quantity of the inerts. The description which follows is based on a low temperature fractionation process.

Ethylene from the refinery gas is augmented by ethylene produced by the pyrolysis of ethane and propane. Cracking is performed in a coil type reactor designed for graduated temperature intensity in conformity with a temperature gradient conducive for maximum ethylene yield and minimum coke formation.

The cracked gas is compressed to the pressure required by the demethanizer. This pressure will vary with the concentration of hydrogen and methane, and the recovery of ethylene desired. Compressed gas is cooled, dried and fed to the low temperature demethanizing tower.

The demethanized bottoms are then deethanized by low temperature fractionation to produce ethylene and ethane overhead, and a propylene and heavier bottoms stream. The ethylene-ethane stream is separated at low temperature to produce ethylene of desired purity and an ethane stream which is vaporized and recycled to the cracking furnaces, the vaporization providing refrigeration for ethylene reflux condensation.

The propylene and heavier stream from the deethanizer is depropanized to recover a propylene-propane stream which can be cracked to produce additional ethylene, or processed for removal of propylene by polymerization or other means. Butanes and heavier are sent to storage.

The recycle ethane and propane streams may be combined with extraneous ethane and propane fresh feed and fed to the cracking furnaces. Ethane and propane may be cracked in the same or separate furnaces, depending again on process and economic considerations. The furnace effluent is quenched and cooled in a quench tower in which heavy aromatic oil is condensed and separated. Where it is necessary to produce ethylene of minimum acetylene content, the gas is then reheated and passed over a suitable catalyst to convert acetylene to ethylene by selective hydrogenation. The gas is then cooled, combined with the refinery gas fresh feed stream and compressed to demethanizer pressure as previously described.

Refrigeration is by a propane-ethylene cascade system.

YIELDS: Ultimate yields of ethylene from cracking C_2 and C_3 mixtures range from 60 to 80 percent by weight, depending on composition, recycle, and furnace operating conditions. Ethylene recovery and purification systems have been designed to recover 90 to 98 percent of the ethylene produced at purities of 95 to 99.5 percent.

COMMERCIAL INSTALLATIONS: Combined capacity of more than 2 million pounds per day of ethylene.

Ethylene and Propylene

THE LUMMUS COMPANY

APPLICATION: A process for the production, recovery and purification of ethylene and propylene.

CHARGE STOCK: Refinery gases, ethane or propane.

PRODUCTS: Ethylene and/or propylene at the desired purity up to 99.9-mole percent.

DESCRIPTION: The flow diagram illustrates a plant to produce ethylene and propylene from ethane and propane, and to recover these olefins.

Ethane and propane entering as fresh feed plus unconverted ethane and propane are recovered to provide the feed to the cracking heaters.

Separate furnaces are used for cracking ethane and propane in order that each be cracked at the optimum conditions for maximum yield and on stream time. The effluent from the furnaces are quenched with water in separate quench pots to 190 F., combined, and further cooled in shell and tube units before introduction to the compression system. Polymer and aromatic distillates are collected in the quench water surge drum and decanted there. The compression system must be carefully designed to avoid excessive temperatures causing polymerization in the compressors leading to excessive maintenance.

The combined heater effluent and fresh feed is compressed to approximately 500 psig, chilled, and dried over solid desiccants such as activated alumina or bauxite. The feed is chilled to a point just above the hydrate formation point to keep the drier load to a minimum.

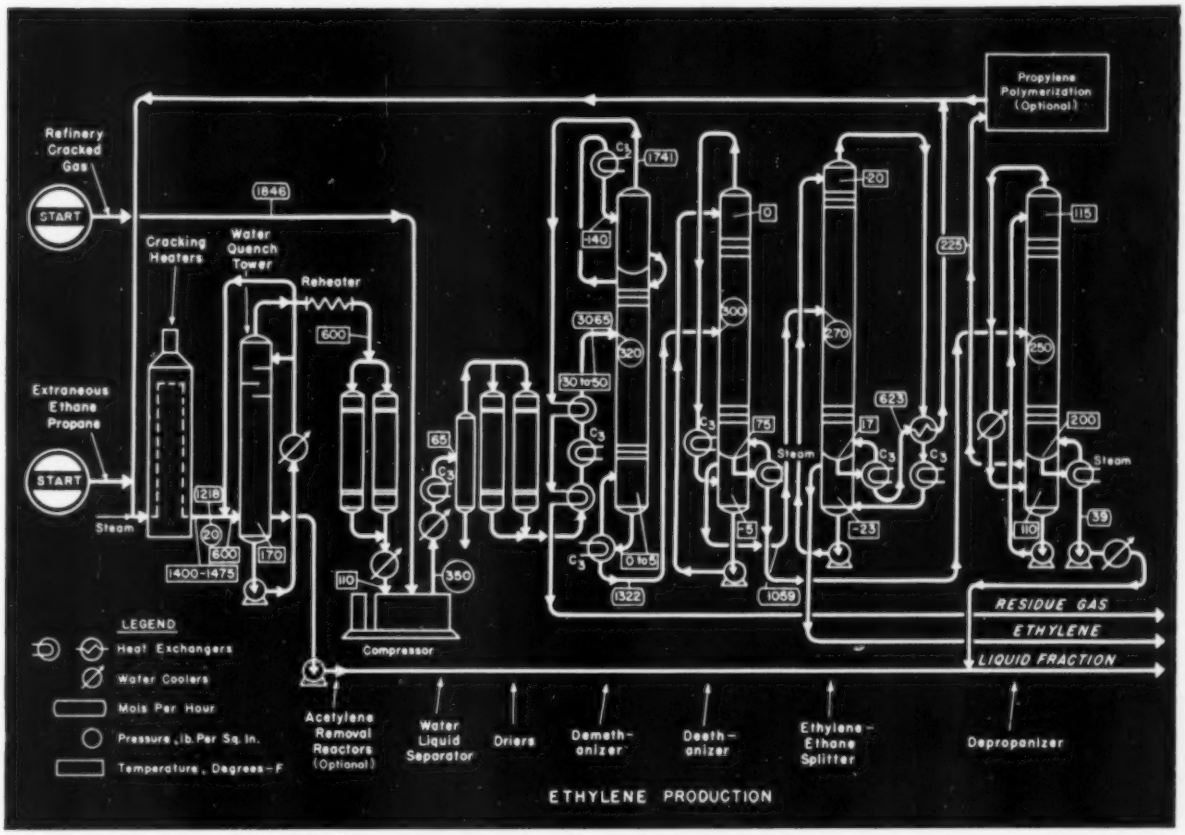
The dried feed is further chilled and introduced into the fractionating absorber. Hydrogen and methane are rejected essentially completely as off-gas, while the ethylene and heavier components are absorbed in the lean oil. In the plant described the lean oil consists of a fraction consisting of C_4 through aromatic distillate. The fat oil is delivered from the bottom of the absorber with a methane concentration referred to ethylene of less than 1 percent and containing over 96 percent of the ethylene in the absorber feed.

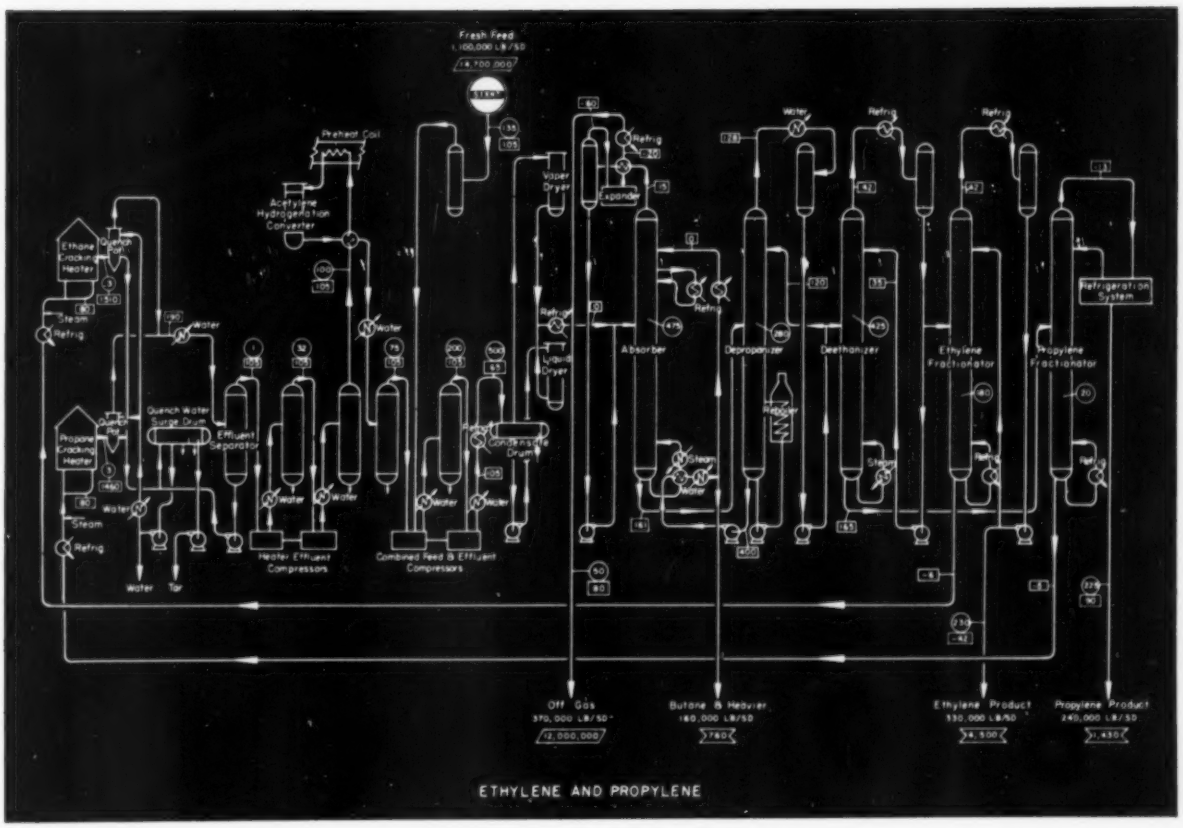
The absorber bottoms are fed to the depropanizer where ethylene, ethane, propylene and propane are taken overhead and the bottoms are recycled as lean oil. The overhead is taken overhead and the bottoms consist of propane and propylene. The overhead is separated in the ethylene fractionator into the ethylene product and an ethane bottoms which is recycled to the cracking heaters. Certain processes require ethylene of purity over 98 mole percent in which case a demethanizer is added between the deethanizer and the ethylene fractionator. The deethanizer bottoms are similarly separated in the propylene fractionator into the propylene product and a propane bottoms which is recycled.

Refrigeration for the unit is supplied by centrifugal compressors using propane as the refrigerant.

YIELD: Approximate yields are shown on the flow sheet. Yields vary with composition of feed stock, conversion per pass in heater and whether propylene is recycled to heater to any extent.

COMMERCIAL INSTALLATIONS: The Lummus Company has designed and constructed ten units producing ethylene and/or propylene from various feed stocks.


Refinery Cracked Gas
START
Extraneous Ethane Propane
START
Steam
Cracking Heaters
Water Quench Tower
Reheater
Compressor
Propylene Polymerization (Optional)
Steam
Steam
RESIDUE GAS
ETHYLENE
LIQUID FRACTION
LEGEND
Heat Exchangers
Water Coolers
Mols Per Hour
Pressure, lb. Per Sq. In.
Temperature, Degrees-F
Acetylene Removal Reactors (Optional)
Water Liquid Separator
Driers
Demeth-anizer
Deeth-anizer
Ethylene-Ethane Splitter
Depropanizer
ETHYLENE PRODUCTION


Fresh Feed
Preheat Coil
Acetylene Hydrogenation Converter
Ethane Cracking Heater
Propane Cracking Heater
Quench Pot
Quench Water Surge Drum
Effluent Separator
Heater Effluent Compressors
Combined Feed & Effluent Compressors
Condensate Drum
Vapor Dryer
Liquid Dryer
Expander
Absorber
Depropanizer
Deethanizer
Ethylene Fractionator
Propylene Fractionator
Refrigeration System
Refrig
Water
Steam
Tar
Off Gas
Butane & Heavier
Ethylene Product
Propylene Product
ETHYLENE AND PROPYLENE

Ethylene with Pebble Heater

PHILLIPS PETROLEUM COMPANY

APPLICATION: A heating process for attaining temperatures beyond the range of conventional tube furnaces.

CHARGE: The charge may be gaseous hydrocarbons, inert or corrosive gases, steam or air. It is primarily C_1 to C_2 hydrocarbons for ethylene manufacture.

PRODUCT: Ethylene and other unsaturated hydrocarbons, predominantly olefinic. However, the cracked hydrocarbon effluent depends on the processing conditions, i.e., reaction time, pressure and temperature.

DESCRIPTION: In the Pebble Heater process, continuously circulating refractory balls (pebbles) are contacted directly in a reaction chamber with the charge material to be heated or cracked. As shown by the flow diagram, a continuous bed of pebbles extends from the engaging pot upward through the reactor and preheater vessel into the pebble surge at the top of the preheater. This entire bed of pebbles slowly moves downward through the chambers at a rate controlled by a flow control device in the engaging pot. In the lift line the pebbles travel upward in a stream of heated air. The pebbles settle out of the lift air in an enlarged vessel at the top of the lift line and then run down the sloping line to the top of the bed in the pebble surge. As the pebble bed moves downward in the preheater, the pebbles are heated by an upward flow of hot combustion gases. These hot gases are generated under pressure in the bustle-type combustion chamber surrounding the lower portion of the preheater vessel. The hot pebbles then pass through a restricted throat into the reaction chamber where the upward-flowing gaseous charge is heated. The feed is admitted to the lower portion of the reactor through a distributor designed to minimize interference with the flow of pebbles. The resulting cooled pebbles flow downward out of the reactor through a duct into the engaging pot and are returned through the lift to the settling chamber. When processing hydrocarbons the heated gases pass out the top of the reactor into a quench vessel where the temperature may be quickly lowered by direct water spray.

To prevent the undesirable mixing of combustion gases and reactor effluent, a pressure balance is maintained across the throat between the preheater and the reactor. Further to insure separation of the gases, steam is injected into the throat between the chambers. Between the reactor and the engaging pot a steam seal is used to separate the lift gas from the reactor feed.

OPERATING CONDITIONS: The major operating variables for hydrocarbon processing are temperature, pressure and reaction time. For other materials not all of these variables may be significant.

YIELDS: Typical feed stock and corresponding reactor effluent compositions are as follows:

Feed	(Mol. Percent)	Reactor Effluent	(Mol. Percent)
Methane	30.0	Hydrogen	32.0
Ethane	61.0	Methane	29.0
Propane	6.0	Acetylene	1.0
Other	3.0	Ethylene	25.0
		Ethane	11.0
	100.0	Heavy Unsaturates	2.0
			100.0

COMMERCIAL INSTALLATIONS: Following several years of successful pilot plant operation, Phillips has installed a 30 Mm Btu per hour commercial Pebble Heater at Borger, Texas.

Hypersorption

UNION OIL COMPANY OF CALIFORNIA

APPLICATION: Hypersorption is used for the separation of volatile hydrocarbons and other gaseous compounds. It is particularly applicable to the recovery and production of pure hydrogen, methane, acetylene, ethylene, and propylene.

CHARGE: The charge for this process is a gas stream which may be derived from natural gas operations, high temperature cracking operations on either liquid or gaseous hydrocarbons, or steam-methane reforming operations for the production of hydrogen.

DESCRIPTION: Feed gas entering through a distributor passes upward counter-current to the moving bed of activated charcoal. In its passage through the bed, the heavier compounds are adsorbed and retained on the charcoal. The top product gas, comprising the lightest constituents in the feed, disengages from the charcoal below the cooler and passes off through a cyclone. The charcoal passes downward below the feed point to the rectifying section where it contacts a reflux of heavy constituents, separated in the stripper which serves to liberate lighter constituents adsorbed on the downward-moving charcoal. A concentration of these latter constituents in the vapor phase results and if desired they can be disengaged as a side cut product gas at a point between the feed and bottom product gas disengaging sections. As the charcoal flows past the bottom product gas disengaging section into the steaming section, it meets an upward flow of steam which liberates the adsorbed heavy components, and these flow upward either to return as reflux or pass out as bottom product gas from the Hypersorber.

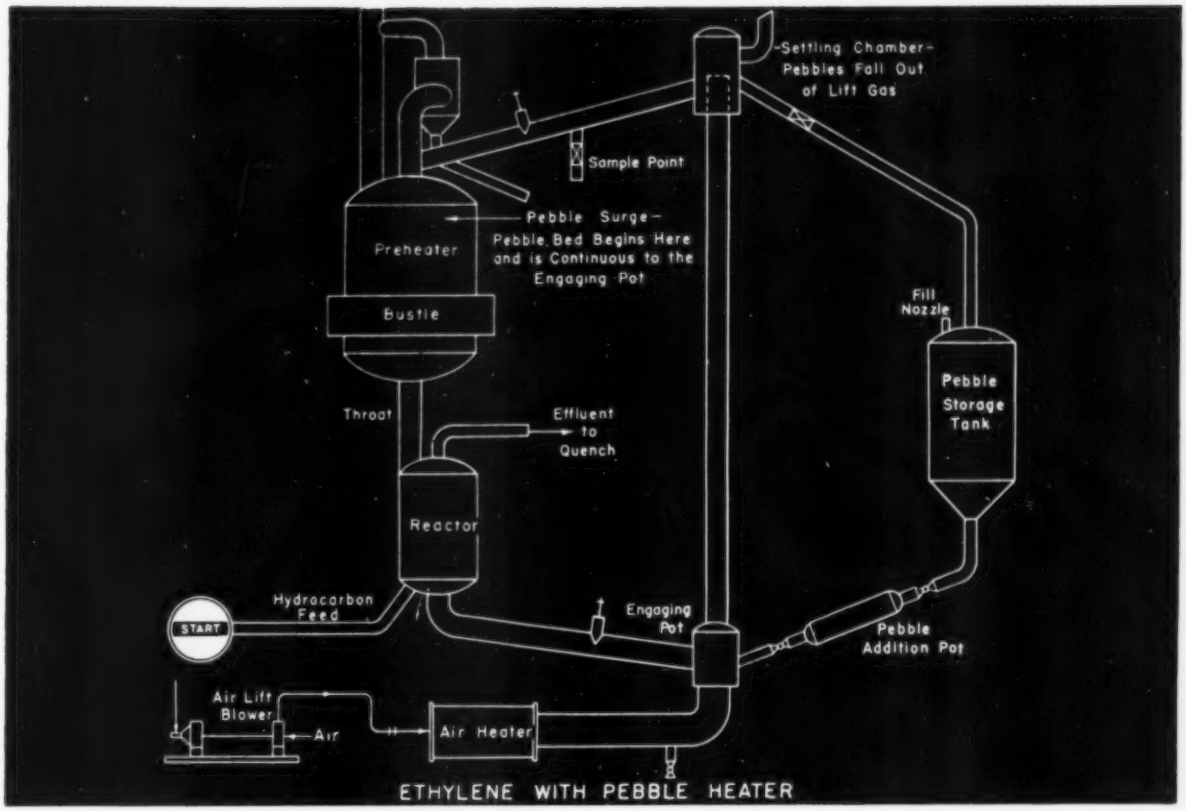
The charcoal flows from the steaming section into the stripping section wherein it passes down through tubes which are heated by a circulating heat-transfer medium and through which steam is passed counter-current to the charcoal. The hottest point in the stripper is at the bottom of this section and substantially all residual adsorbed material is removed during the passage of the charcoal through this zone.

A charcoal regeneration unit, acting in parallel with the Hypersorber, carries out high temperature steam treatment of the charcoal to maintain its activity.

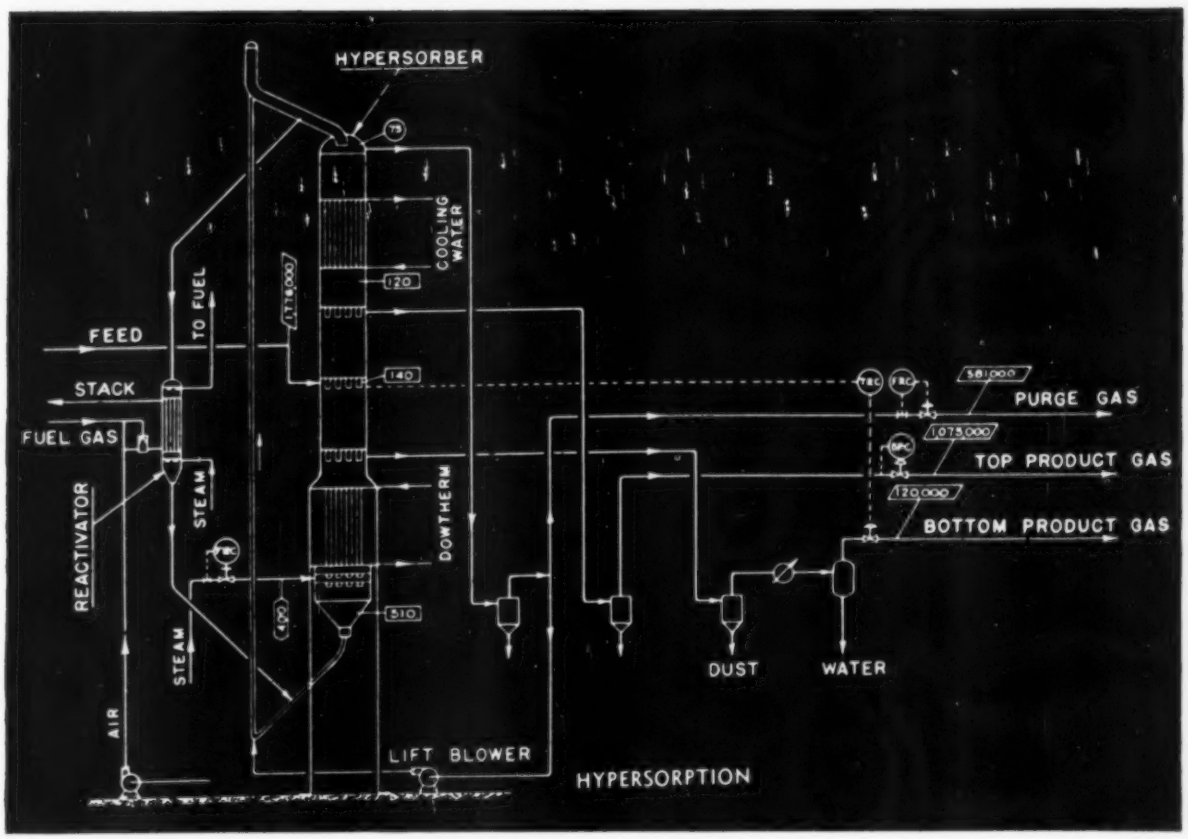
The charcoal is transported to the top of the tower by a gas lift system and is dropped into the reserve charcoal hopper at the top of the unit. The hot charcoal passes down from the hopper into the cooling section consisting of a tube and shell exchanger wherein the charcoal is cooled to the desired temperature for adsorption.

YIELDS: The application of Hypersorption in the recovery of ethylene from a lean gas stream is shown, and the yields in a typical commercial operation are given in the table below.

Comp.	Feed Gas, Volume Percent	Bottoms Product, Volume Percent	Overhead Product, Volume Percent	Purge Gas, Volume Percent
Hydrogen	39.8		31.6	61.8
Nitrogen	1.7		1.4	2.5
Carbon Monoxide	0.9		0.8	1.3
Oxygen	0.1	0.1	0.1	0.2
Methane	51.3		66.1	33.7
Carbon Dioxide	0.2	2.9		0.1
Acetylene	0.2	3.6		
Ethylene	5.8	92.7		0.4
Ethane	Trace	0.7		
Total	100.0	100.0	100.0	100.0



ETHYLENE WITH PEBBLE HEATER



HYPERSORPTION

Ethyl Chloride

APPLICATION: This is a process applied to the manufacture of ethyl chloride.

CHARGE: Hydrogen chloride (anhydrous) and ethylene of 90-95 percent purity (anhydrous) are the charge materials.

PRODUCT: Ethyl chloride of 99 percent purity is the product.

DESCRIPTION: The most important commercial process for making ethyl chloride is based on ethylene and hydrogen chloride raw materials, and is discussed in detail. The other major process is based on ethanol and hydrogen chloride raw materials. Dry ethylene and dry hydrogen chloride are mixed in approximately equal molar proportions and charged to the reactor at 95-100 F. The reactor is a vertical vessel containing liquid ethyl chloride in which anhydrous aluminum chloride catalyst is dissolved. The reaction which occurs is:

$$C_2H_4 + HCl \xrightarrow{AlCl_3} C_2H_5Cl$$

The operating temperature is about 105 F., and cooling coils are provided to remove the exothermic heat of reaction. The operating pressure is 2.5-3.0 atmospheres. Vapor space velocity is on the order of 100 hour^{-1}. Conversion of both reactants is essentially complete, and the ethyl chloride yield is about 90 percent.

The overflow from the reactor is heated and the net ethyl chloride make is vaporized. The vapor is disengaged in a flash drum and passes to the purification system. The liquid goes to a surge tank where aluminum chloride catalyst is added, and the mixture is cooled and returned to the reactor.

The vapor from the flash drum is primarily ethyl chloride, with minor contaminants being methane, ethane, ethylene, hydrogen chloride, and heavier chlorinated materials. Hydrogen chloride is removed by scrubbing with hot water. The gas then passes to the ethyl chloride tower. Non-condensables go overhead. Product ethyl chloride is removed as a liquid, is decanted from the water and is sent to storage.

In the alcohol process, ethyl chloride is formed according to the reaction:

$$C_2H_5OH + HCl \xrightarrow{ZnCl_2} C_2H_5Cl + H_2O$$

Alcohol and hydrogen chloride are charged to a reactor containing an aqueous solution of zinc chloride catalyst. The reactor operates at about 2 atmospheres pressure and 290 F. The product ethyl chloride passes off as a vapor, along with some water and hydrogen chloride. The latter is removed by water scrubbing at 175 F. The ethyl chloride-water mixture is then condensed and the water decanted. Yields for the process are on the order of 95 percent.

OPERATING CONDITIONS: Equilibrium in the ethylene-hydrogen chloride reaction becomes unfavorable with increasing temperature. The operating conditions given represent a compromise between slower reaction rate and higher equilibrium yield.

YIELDS: Over-all process yield, based on either ethylene or hydrogen chloride, is 88-90 percent.

COMMERCIAL INSTALLATIONS: This ethylene process or a variation is used at the following plants: Ethyl Corporation, Baton Rouge, La., Deer Park, Texas; The Dow Chemical Company, Midland, Michigan, Freeport, Texas; Shell Chemical Company, Deer Park, Texas.

Vinyl Chloride from Acetylene

NAUGATUCK CHEMICAL

APPLICATION: A process for the manufacture of vinyl chloride.

CHARGE: Acetylene and hydrogen chloride are the charge.

PRODUCT: The product is vinyl chloride monomer.

DESCRIPTION: Hydrogen chloride gas with a water content of less than 0.02 weight percent is mixed with dry acetylene in a vapor blender to react in equal molar quantities. Actually, about 10 percent excess hydrogen chloride is used. The hydrogen chloride must be dry to avoid excessive corrosion and to hold down the quantity of acetaldehyde formed as a by-product. From the vapor blender, the gas mixture is fed to multi-tube reactors. The reactors are connected in banks of nine for parallel flow of gases. Each tube is packed with activated carbon pellets impregnated with catalyst containing mercuric chloride.

The reaction must be initiated by heat supplied to the reaction mass using a circulating heating medium on the shell side of the reactor. Once the reaction is started, it is highly exothermic and the circulating medium used to supply heat is now used as a coolant.

The temperature in the reactor is controlled between 280-400 F. The exact temperature is dependent upon the catalyst age, a higher temperature being needed as the catalyst age increases.

Gases from the reactor contain the product, vinyl chloride, as well as by-products such as ethylidene dichloride and aldehydes. Small amounts of unreacted hydrogen chloride and acetylene are also present. These gases are cooled before being fed to a combination stripping and fractionating operation. In this operation the unreacted acetylene and hydrogen chloride are removed from the crude vinyl chloride.

In a refrigerated fractionating column, the vinyl chloride is taken overhead. The ethylidene chloride and the aldehydes are removed from the bottom of this tower. These by-products then go to a pot still where the ethylidene chloride is separated from the aldehydes.

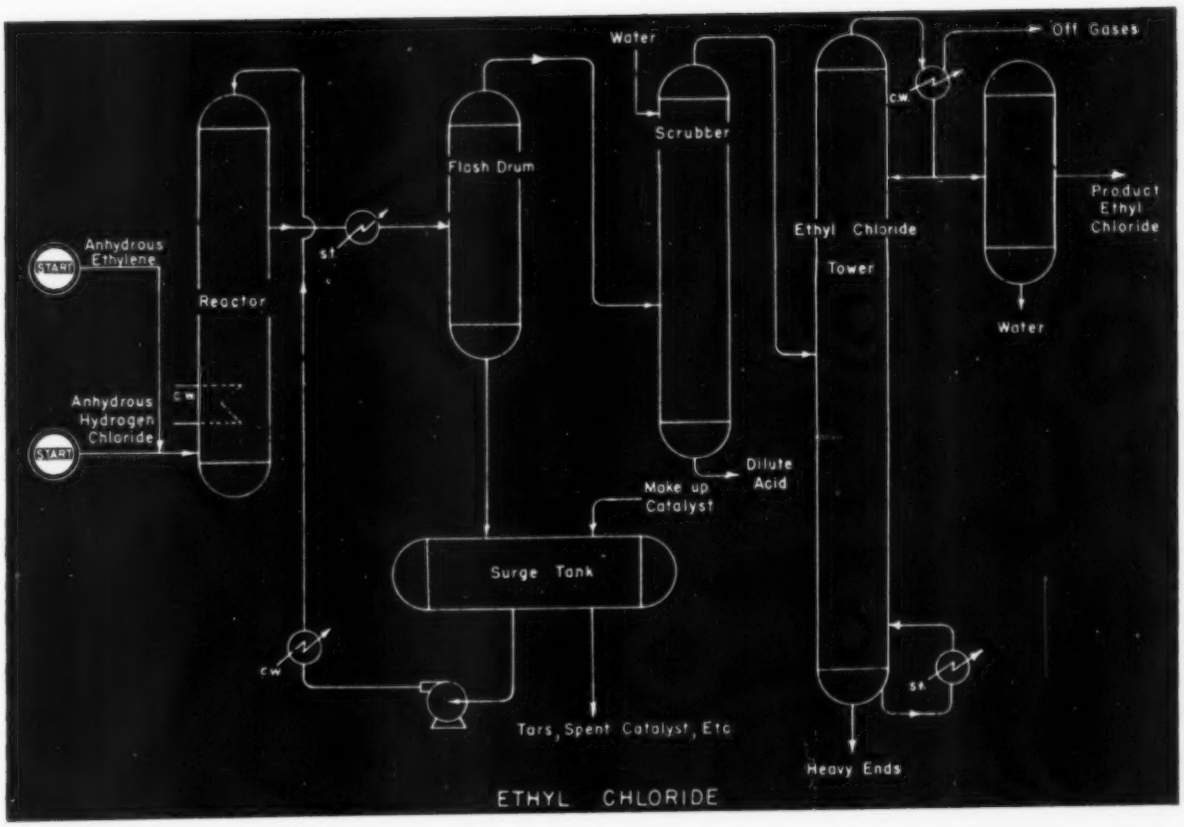
The vinyl chloride going overhead is sent to a scrubber where trace impurities are removed by caustic and water. From the scrubber, the vinyl chloride is sent to storage after the addition of a small amount of phenol which acts as a polymerization inhibitor. Storage tanks for vinyl chloride monomer are stainless steel.

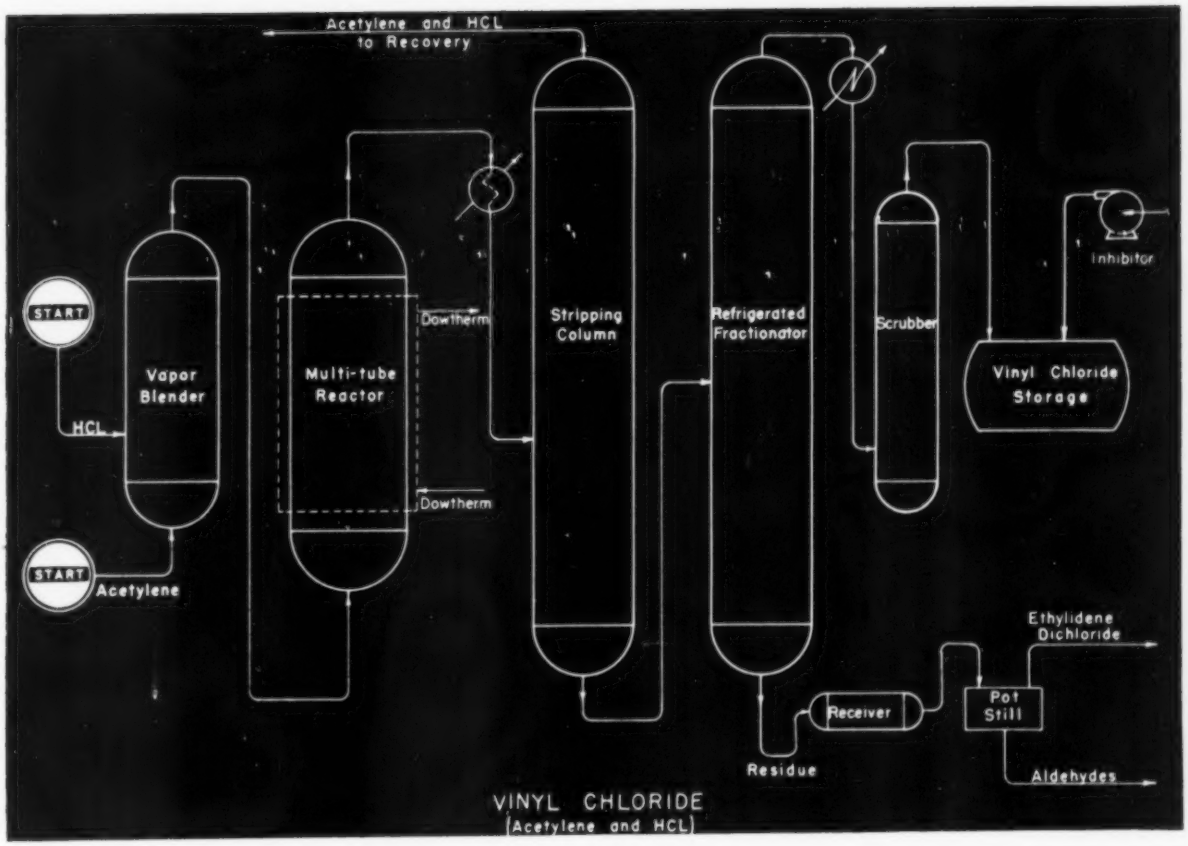
OPERATING CONDITIONS: The major operating conditions are given in the text of the description.

YIELDS: Typical yield data are given below:

Yield of vinyl chloride, based on acetylene—80-85 percent.

Acetylene consumption—42-46 pounds/100 pounds vinyl chloride.


Water
Off Gases
Scrubber
Flash Drum
Ethyl Chloride
Tower
Product
Ethyl
Chloride
Anhydrous
Ethylene
START
Reactor
Water
Anhydrous
Hydrogen
Chloride
START
Dilute
Acid
Make up
Catalyst
Surge Tank
Tars, Spent Catalyst, Etc
Heavy Ends
ETHYL CHLORIDE


Acetylene and HCL
to Recovery
START
Vapor
Blender
HCL
Multi-tube
Reactor
Dowtherm
Dowtherm
Stripping
Column
Refrigerated
Fractionator
Scrubber
Inhibitor
Vinyl Chloride
Storage
START
Acetylene
Ethylidene
Dichloride
Receiver
Pot
Still
Residue
Aldehydes
VINYL CHLORIDE
(Acetylene and HCL)

Vinyl Chloride from Ethylene

APPLICATION: A process for manufacturing vinyl chloride from ethylene and chlorine.

CHARGE: Ethylene, 90-95 percent purity; chlorine, 99+ percent purity.

PRODUCT: Vinyl chloride monomer, 99.5+ percent purity.

DESCRIPTION: The production of vinyl chloride from ethylene and chlorine is based on the intermediate production of ethylene dichloride (1,2 dichloroethane). There are two commercially-important processes for the dehydrochlorination of the ethylene dichloride to form vinyl chloride. Both will be described below.

Ethylene Dichloride—Ethylene gas and chlorine gas are blended in a molar ratio of 1.05-1.10 to 1.00 and charged to the reactor. The reaction takes place in the liquid phase in the presence of a considerable quantity of reaction products. The exothermic reaction heat is removed either by internal cooling tubes or by circulation through an external heat exchanger. The reaction is quite rapid, and the design of the reactor is not especially critical. The reactor is usually a vertical steel vessel half-filled with ethylene dichloride. Gases are admitted through sparger pipes at the bottom of the vessel.

The reactor contents are maintained at 100-120 F. The operating pressure is 10-20 psig. Chlorine conversion is essentially 100 percent. The yield of ethylene dichloride from chlorine is 90-95 percent. The side-products include hydrogen chloride and polychloroethanes. It is sometimes feasible to add small amounts of materials such as ferric chloride or ethylene dibromide to increase the yield of ethylene dichloride.

Both vapor and liquid products are removed from the reactor. The vapors pass to a brine-cooled condenser for the recovery of ethylene dichloride and thence to a scrubbing tower where hydrogen chloride is removed with dilute caustic. The vapors finally issuing from the vent contain methane, ethylene, and ethane.

The liquid products from the reactor are washed with 6-8 percent caustic in an agitated vessel. They then pass through a coalescer to a separator tank where the lower layer of crude ethylene dichloride is withdrawn. Final purification of the ethylene dichloride is accomplished in a conventional fractionator. Product of 99+ percent purity is withdrawn and placed in storage.

Vinyl Chloride by the Thermal Process—Fresh and recycle ethylene dichloride in approximately equal proportions form the charge for this process. The charge is pumped to about 50 psig, vaporized in a steam-heated exchanger, and passed through a bed of desiccant for removal of water traces which might give corrosion problems later in the process. The dry vapor then enters the cracking furnace, which is a conventional direct-fired heater containing a plurality of stainless steel tubes. The tubes are fired such that the exit gas reaches a temperature of 900-950 F. About 50 percent of the ethylene dichloride is cracked, according to the reaction:

$$C_2H_4Cl_2 \rightarrow C_2H_3Cl + HCl$$

The yield of vinyl chloride is high, on the order of 95-98 percent. A certain amount of carbon deposition occurs, and the cracking unit must be shut down periodically for coke removal. Some operators have found it advantageous to pack the reaction section tubes with non-porous material such as smooth gravel in order to minimize skin-cracking.

The effluent gases are quenched rapidly by direct-contact with a stream of recycle ethylene dichloride. The gases from the quencher pass through a surface condenser, and the noncondensibles are finally scrubbed with water to recover the hydrogen chloride.

The combined liquid streams from quencher and condenser are pumped to a fractionation system where vinyl chloride of 99.5+ percent purity is obtained. The vinyl chloride tower operates at a sufficient pressure that the overhead stream can be totally condensed by chilled water. The product vinyl chloride monomer is stored in pressure tanks at low temperature.

Vinyl Chloride by the Caustic Process—Fresh and recycle ethylene dichloride is mixed with 6 percent caustic in a mole ratio 2:1 ethylene dichloride: sodium hydroxide and charged to a steel reactor. The reactants are pumped and heated such that the reaction conditions are approximately 150 psig and 290 F. After a residence time of 2-3 minutes the ethylene dichloride is converted to the extent of 90 percent, according to the reaction:

$$C_2H_4Cl_2 + NaOH \rightarrow C_2H_3Cl + NaCl + H_2O$$

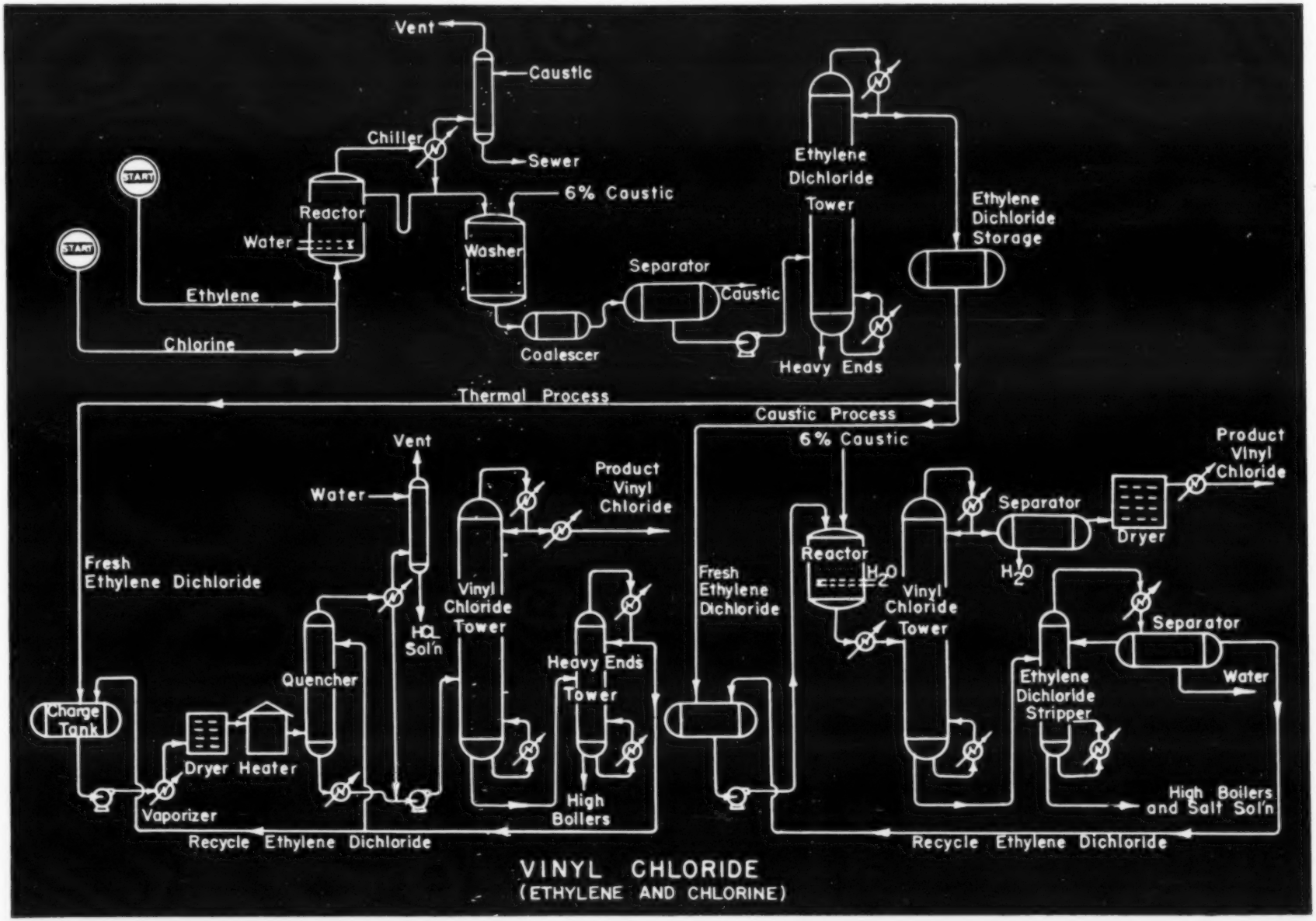
The yield of vinyl chloride is almost quantitative; minor side-products are ethylene glycol, acetylene, and acetaldehyde.

The overflow from the reactor is cooled and pressured to the vinyl chloride column which operates at a pressure such that overhead product can be condensed by chilled water. The product vinyl chloride monomer is stored in pressure tanks at low temperature.

The bottoms stream from the vinyl chloride tower passes to another still where a water-ethylene dichloride azeotrope is carried overhead. Water is decanted and the dichloride is recycled to process. The bottoms stream from this final still contains high boilers, salt, and water, and is discarded.

YIELDS: Over-all process yield, vinyl chloride from chlorine or ethylene: 90 percent.

COMMERCIAL INSTALLATIONS: This process or a variation is used at the following plants: Carbide and Carbon Chemicals Company, Texas City, Texas; Monsanto Chemical Company, Texas City, Texas; Dow Chemical ompany, Freeport, Texas, Midland, Mich.; Diamond Alkali Company, Deer Park, Texas.


Vent
Caustic
Chiller
Sewer
START
START
Reactor
Water
6% Caustic
Washer
Ethylene
Chlorine
Coalescer
Separator
Caustic
Ethylene Dichloride Tower
Heavy Ends
Ethylene Dichloride Storage
Thermal Process
Caustic Process
6% Caustic
Vent
Water
Product Vinyl Chloride
Fresh Ethylene Dichloride
Vinyl Chloride Tower
HCL Sol'n
Heavy Ends Tower
Quencher
Charge Tank
Dryer Heater
Vaporizer
High Boilers
Recycle Ethylene Dichloride
Fresh Ethylene Dichloride
Reactor
H_2O
Vinyl Chloride Tower
Separator
H_2O
Dryer
Product Vinyl Chloride
Separator
Water
Ethylene Dichloride Stripper
High Boilers and Salt Sol'n
Recycle Ethylene Dichloride
VINYL CHLORIDE
(ETHYLENE AND CHLORINE)

Glycerol

APPLICATION: This process is for the manufacture of synthetic glycerol.

CHARGE: Propylene, 98 percent purity and chlorine 99+ percent purity are the charge.

PRODUCT: Glycerol (glycerine), 99+ percent purity, is the product.

DESCRIPTION: For convenience ,the synthetic glycerol process may be divided into three successive operations, the end products of which are allyl chloride, epichlorohydrin, and finished glycerol (termed "glycerine" in commercial practice). A portion of the allyl chloride produced is used in the manufacture of allyl alcohol. Similarly, a portion of the epichlorohydrin produced is used in the manufacture of epoxy resins. Although synthetic glycerol production accounts for a small portion of the nation's total, it serves the very important function of buffering the otherwise-fluctuating price of glycerol.

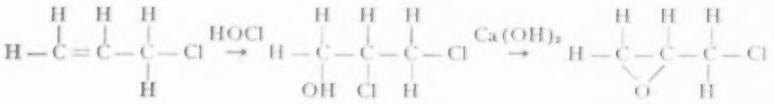
Allyl chloride is produced by the hot chlorination of propylene. Substitution rather than addition of chlorine takes place. This is the most important step in the synthesis and the one which presented most difficulties in the original development.

Fresh liquid propylene is fed to a storage tank where it is blended with recycle propylene in a ratio of about 1:3. The blend is dried over a solid desiccant, preheated to 650-700 F. in a fired tubular heater, and mixed rapidly with cold chlorine gas. The reactor is a simple steel tube which is operated adiabatically. The reaction is exothermic and the products leave at 950 F. The ratio of propylene to chlorine in the feed is 4:1. Conversions of propylene and chlorine are about 25 percent and 100 percent, respectively. The yield of allyl chloride is 80-85 percent. The operating pressure is 15 psig. A certain amount of coking occurs and a multiple-unit arrangement allows periodic de-coking without disturbance of operating continuity.

The effluent gases are cooled quickly to 120 F. in a tubular exchanger and are sent to the prefractionator. Unconverted propylene plus hydrogen chloride are removed overhead. Reflux is dry liquid propylene at —40 F. The overhead gas is scrubbed first with water and then with caustic before being compressed, liquefied, and returned to charge propylene storage. A by-product stream of 32 weight-percent HCl is recovered from the water-scrubbing operation.

The bottoms stream from the prefractionator contains about 75 weight-percent allyl chloride. Dichloropropane is the major contaminant. Purification is effected in two conventional fractionators. The first serves to remove the 1-2 percent light ends present in the crude allyl chloride and the second serves to remove dichloropropane and other high boilers. The purified allyl chloride is placed in storage for use in the manufacture of allyl alcohol and glycerol.

Epichlorohydrin is produced from allyl chloride by the following reactions:



Chlorine and water are reacted in a tower to form a solution of hypochlorous acid which is in turn reacted with allyl chloride in a stirred tank to form a mixture of dichlorohydrins. The desired reaction takes place in the aqueous phase, and a minimum of allyl chloride is allowed in the reaction zone in order to avoid side reactions in the non-aqueous (allyl chloride) phase. The reaction is exothermic but readily maintained in the 85-100 F. range by the excess of acid.

The reactor effluent passes to a separator tank where the aqueous phase is removed and recirculated to the chlorinating tower. The non-aqueous phase, containing the mixture of dichlorohydrins, is fed to a stirred reactor where it is contacted with a lime slurry. The reactor contents are maintained below 140 F. Essentially complete conversion to epichlorohydrin is obtained. The product is steam-distilled at atmospheric pressure as a water azeotrope which contains in addition a small amount of unreacted dichlorohydrin. Epichlorohydrin of 98 percent purity is obtained from a final distillation.

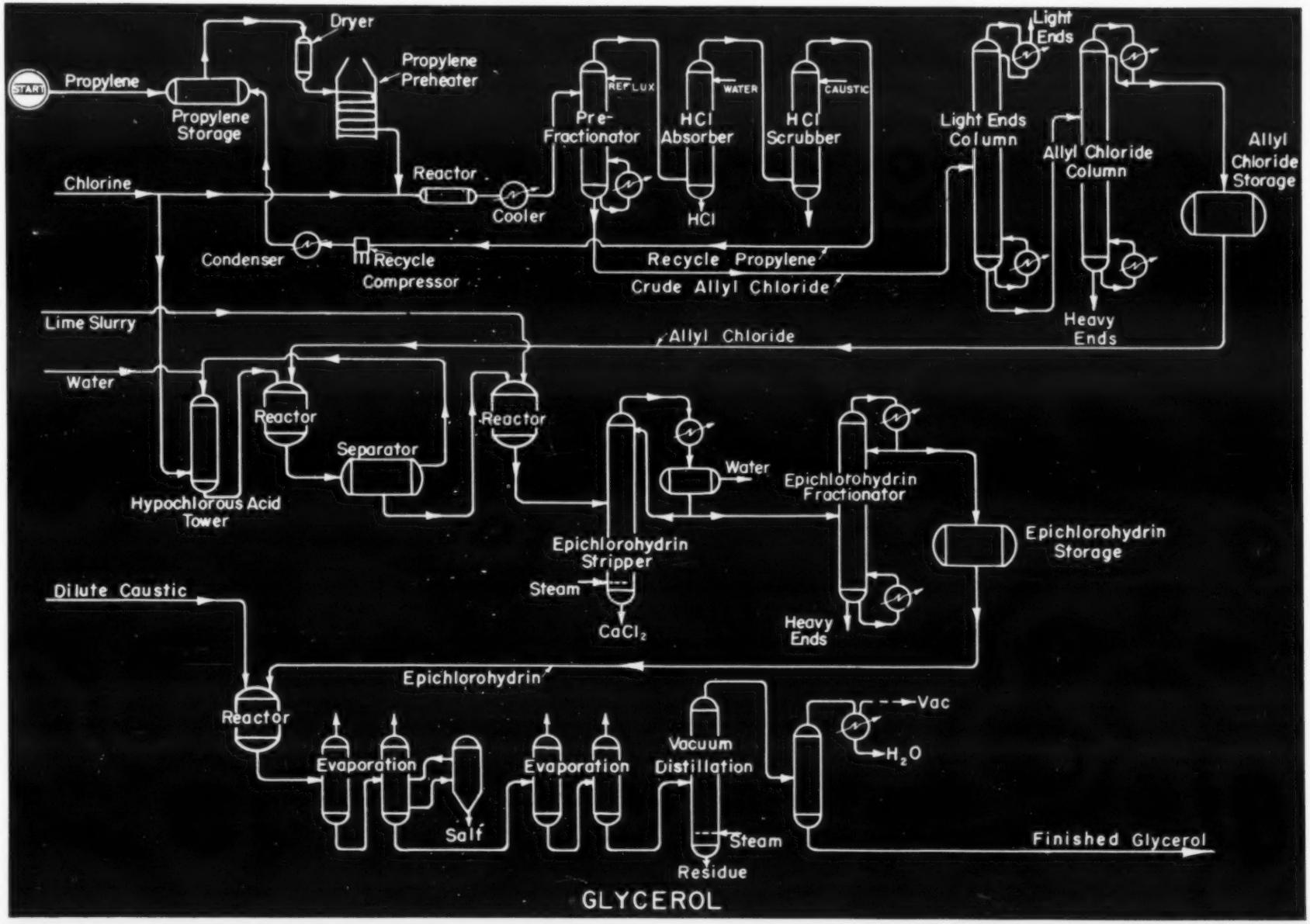
Glycerol is formed by the hydrolysis of epichlorohydrin, using sodium hydroxide. Dilute (about 10 percent) caustic is added to the epichlorohydrin in a stirred tank. Essentially complete conversion to glycerol is obtained. The effluent from the tank is a dilute solution of glycerol containing sodium chloride. Salt and most of the water are removed in a multiple-effect evaporation system. At an intermediate point the salt crystallizes and is removed from the bottom of the evaporator. A certain amount of glycerol is recovered from the ensuing settling operation and is recycled to the evaporation system. Reduced pressure is used in the latter stages of the evaporation. Crude glycerol of about 90 percent purity is obtained.

Glycerol of 99+ percent purity is obtained in a final vacuum distillation operation. It is stored in nickel-clad steel tanks and shipped from the plant in aluminum tank cars.

OPERATING CONDITIONS: The key reaction in the glycerol synthesis is the hot chlorination of propylene. Typical operating conditions for this reaction are given in the above text.

YIELDS: Over-all process yield, glycerol from propylene and chlorine is 75-80 percent.

COMMERICAL INSTALLATION: This process or a variation is used at Shell Chemical Company at Deer Park, Texas. A plant at Norco, La., is planned.


START
Propylene
Propylene Storage
Dryer
Propylene Preheater
Chlorine
Reactor
Cooler
Pre-Fractionator
REFLUX
HCl Absorber
WATER
HCl
HCl Scrubber
CAUSTIC
Light Ends
Light Ends Column
Allyl Chloride Column
Allyl Chloride Storage
Condenser
Recycle Compressor
Recycle Propylene
Crude Allyl Chloride
Heavy Ends
Lime Slurry
Allyl Chloride
Water
Reactor
Separator
Reactor
Hypochlorous Acid Tower
Water
Epichlorohydrin Fractionator
Epichlorohydrin Stripper
Epichlorohydrin Storage
Steam
$CaCl_2$
Heavy Ends
Dilute Caustic
Epichlorohydrin
Reactor
Vac
H_2O
Evaporation
Salt
Evaporation
Vacuum Distillation
Steam
Residue
Finished Glycerol
GLYCEROL

Ethylene Oxide

THE ATLANTIC REFINING COMPANY
THE VULCAN COPPER & SUPPLY COMPANY

APPLICATION: A process for making ethylene oxide.

CHARGE: Ethylene of 95+ percent purity.

PRODUCT: Ethylene oxide of 99.5 percent purity.

DESCRIPTION: Ethylene oxide is made by the direct oxidation of ethylene. Ethylene and air are mixed with recycle gas and passed through a multitube reactor, each tube of which is filled with a fluidized silver catalyst. The tubes are kept full by a layer of catalyst held above the tube sheet. Specially designed orifices assure equal gas distribution. A dowtherm system removes the heat of reaction and gives the required close temperature control. The dowtherm vapors when condensed form steam for the process. The reaction is quenched right after the catalyst bed by internal cooling coils. Filters remove any entrained catalyst from the gases. After further cooling the gases flow to the primary absorber where they are scrubbed with water to extract the ethylene oxide. The absorber is in countercurrent operation.

The oxide-free gas is recompressed. Part of the stream is recycled to the primary reactor, and part, with a small amount of air added, is fed to the second stage reactor. This reactor, of the same design as the primary, is operated on a once through basis. Exit gases are cooled and then scrubbed with water in the second stage absorber. The oxide-free gas may be vented or go to a third stage.

The absorbates from the two absorbers are combined and fed to the top of a bubble cap stripping column after heat exchange with the bottoms-stripped absorbent from the stripper. Stripped absorbent is returned to the absorbers. In the stripper column ethylene oxide and other gases are stripped from the absorbate by open steam. A mixture of ethylene oxide, water and carbon dioxide goes overhead to a partial condenser where water is separated and refluxed to the stripper.

The uncondensed vapors are fed to a rectifying column. The bottoms stream is returned to the stripper as reflux. The overhead stream is partially condensed. The condensate is refluxed, and the uncondensed gases are sent to an atmospheric vent gas scrubber for recovery of any ethylene oxide present in the gas.

A sidestream from the column, containing the ethylene oxide product and carbon dioxide, is fed to the oxide stripper where the carbon dioxide is removed overhead. This stream is returned to the rectifying column, and the bottom stream, the ethylene oxide product, is cooled and sent to storage in spheres under inert gas.

The catalyst is a specially prepared silver catalyst with good fluidization characteristics. No regeneration or reactivation of the catalyst is needed, and in the captive fluid bed no attrition problem has yet appeared. The reactions involved are simple.

$$(1)\ C_2H_4 + \tfrac{1}{2}\,O_2 \rightarrow C_2H_4O$$
$$(2)\ C_2H_4 + 3\,O_2 \rightarrow 2\,CO_2 + 2\,H_2O$$

High temperatures favor reaction (2), and close temperature control is necessary to avoid local hot spots.

OPERATING CONDITIONS: Reaction temperatures are 400 to 600 F. Pressures are 100 to 150 psig.

YIELDS: The over-all yield of ethylene oxide is 55-65 percent, based on ethylene. At the present the economic yield is closer to 55 percent. Conversion in the primary reactor is 35-50 percent and in the second 50-70 percent.

Ethylene Oxide and Ethylene Glycol

STONE & WEBSTER-BADGER

APPLICATION: This is a process for the direct oxidation of ethylene over a silver catalyst to ethylene oxide, which is recovered as a pure product or hydrated to ethylene glycols.

CHARGE: High purity ethylene and air or oxygen.

PRODUCTS: High purity ethylene oxide, mono and diethylene glycols and polyglycols are produced.

DESCRIPTION: Air is scrubbed with dilute caustic to remove impurities harmful to the catalyst, and compressed to the reactor operating pressure. It is preheated by exchange with dowtherm from the first stage reactor cooling system and after mixing with the ethylene feed, passed directly to the first stage reactors. The reactor effluent is quenched with water and ethylene oxide is recovered in a conventional absorption-stripping system, using water as the solvent. Ethylene oxide is obtained as a sidestream from the stripping column, and requires no further purification. The stripped solvent is cooled by exchange with the absorber bottoms stream and in a final refrigerated cooler before returning to the absorber.

The absorber effluent gases are preheated with dowtherm from the first stage reactor cooling system before entering the second stage reactors, where residual ethylene is reacted to give high overall conversions. The hot gas from the reactors is water quenched and then passed directly to the hydrator for catalytic hydration of ethylene oxide to ethylene glycols in dilute solution.

The dilute glycols pass through an ion exchange unit to remove the catalyst and are concentrated by multiple effect evaporation and distillation of the water. The concentrated glycol stream from the dehydration column bottom is further processed in the glycol rerun column and the diglycol fractionator to give pure mono and diethylene glycol products and a crude triethylene glycol stream. Where ethylene glycols are the only desired products, the ethylene oxide produced in the first stage reactors may be either concentrated and subsequently hydrated or the dilute gas stream may be passed directly to a hydrator. In the latter instance, the dilute glycol streams from the first and second stage hydrators are processed in a common system as previously described.

The key to the successful operation of this process lies in close temperature control of the reaction and in proper allowance in the reactor design for piston flow and the rate controlling processes of diffusion.

The principal reactions occurring are:

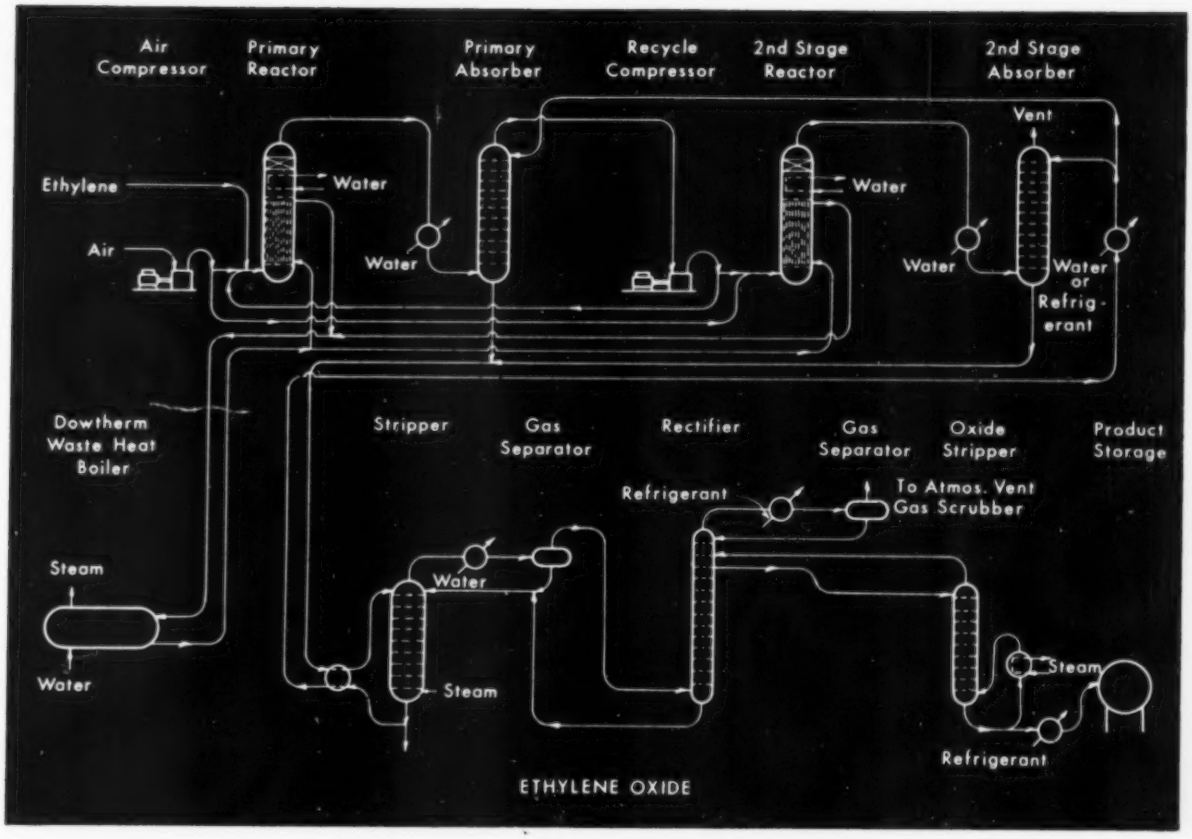
$C_2H_4 + 3\,O_2 \rightarrow 2\,CO_2 + 2\,H_2O\ (g) + 570{,}000$ Btu/mole
$C_2H_4 + \tfrac{1}{2}\,O_2 \rightarrow C_2H_4O\ (g) + 63{,}000$ Btu mole

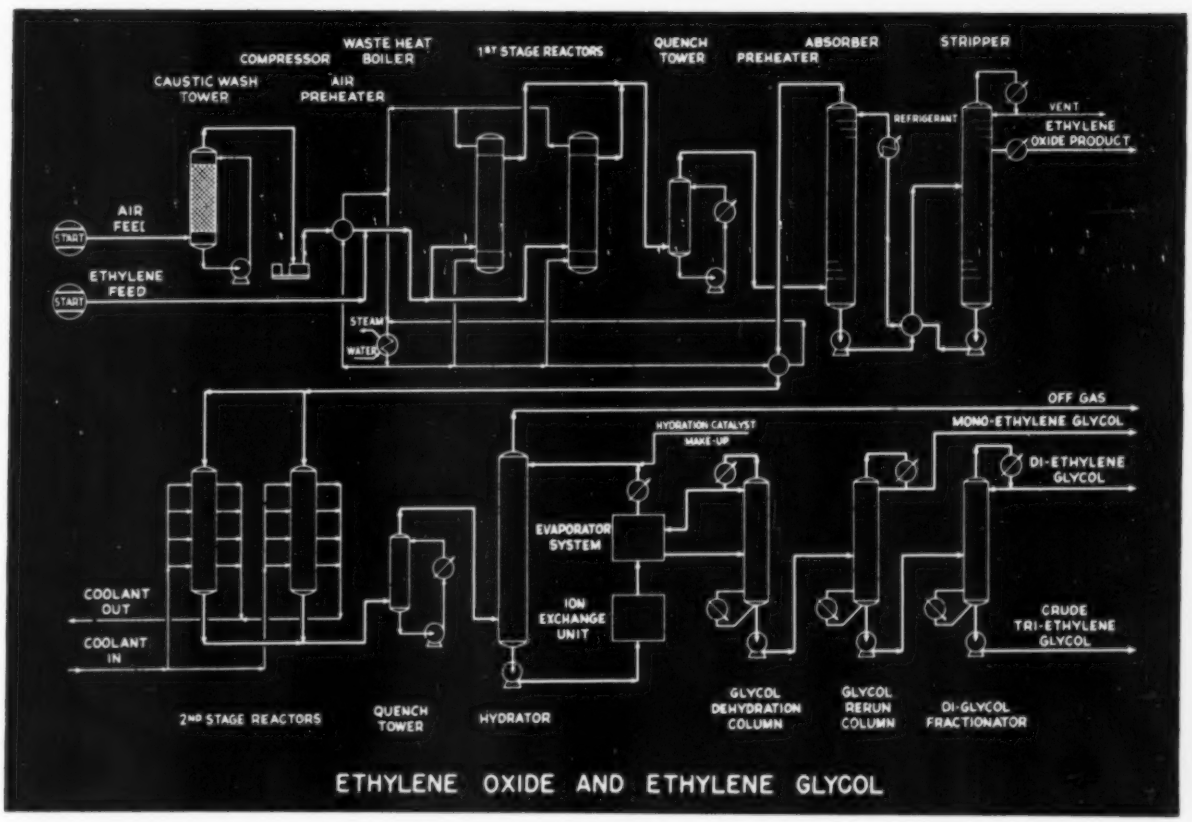
The silver catalyst is the Cambron catalyst developed by the National Research Council of Canada over the last decade. It has a long life and if accidental poisoning occurs, can be readily reactivated. The catalyst is not affected by repeated interruption of operation.

OPERATING CONDITIONS: The first stage reactors operate at about 500 F, and the second at 500-525 F.

YIELDS: Overall conversion of ethylene to ethylene oxide is about 56 percent, with a total conversion of ethylene of about 93 percent. Glycol yields depend on the desired conversion of ethylene oxide to glycols.

COMMERCIAL INSTALLATIONS: The process has been evaluated in the pilot plant and design factors have been established.


Air Compressor
Primary Reactor
Primary Absorber
Recycle Compressor
2nd Stage Reactor
2nd Stage Absorber
Vent
Ethylene
Water
Air
Water
Water
Water
Water or Refrigerant
Dowtherm Waste Heat Boiler
Stripper
Gas Separator
Rectifier
Gas Separator
Oxide Stripper
Product Storage
Refrigerant
To Atmos. Vent Gas Scrubber
Steam
Water
Water
Steam
Steam
Water
Refrigerant
ETHYLENE OXIDE


COMPRESSOR
WASTE HEAT BOILER
1ST STAGE REACTORS
QUENCH TOWER
ABSORBER PREHEATER
STRIPPER
CAUSTIC WASH TOWER
AIR PREHEATER
REFRIGERANT
VENT
ETHYLENE OXIDE PRODUCT
AIR FEED
START
ETHYLENE FEED
START
STEAM
WATER
OFF GAS
HYDRATION CATALYST
MAKE-UP
MONO-ETHYLENE GLYCOL
DI-ETHYLENE GLYCOL
EVAPORATOR SYSTEM
ION EXCHANGE UNIT
COOLANT OUT
COOLANT IN
CRUDE TRI-ETHYLENE GLYCOL
2ND STAGE REACTORS
QUENCH TOWER
HYDRATOR
GLYCOL DEHYDRATION COLUMN
GLYCOL RERUN COLUMN
DI-GLYCOL FRACTIONATOR
ETHYLENE OXIDE AND ETHYLENE GLYCOL

Acrylonitrile

APPLICATION: A process for manufacturing acrylonitrile from acetylene and hydrogen cyanide.

CHARGE: Acetylene gas (99 percent purity); hydrogen cyanide gas (99+ percent purity).

PRODUCT: Acrylonitrile liquid of 99.5 percent purity (dry basis), which is used in nitrile rubber, acrylic fibers, and plastics.

DESCRIPTION: Acrylonitrile may be produced either by the dehydration of ethylene cyanohydrin or by the direct combination of acetylene and hydrogen cyanide. The latter method is known as the "natural gas process" since the two reactants may be derived directly from methane. It is the more important method today, commercially, and accordingly will be described here.

Acetylene and hydrogen cyanide in a ratio of 10:1 form the reactor charge. The reactor is a rubber-lined cylindrical vessel containing liquid catalyst to a depth of several feet. The reactants are injected separately under the liquid surface. About 10 percent of the acetylene is converted, and this consumes practically all of the hydrogen cyanide.

The catalyst is an aqueous solution of cuprous chloride, containing in addition hydrogen chloride and alkali chlorides. The solution contains about 36 weight percent water. At 175 F, all salts are dissolved and this temperature is maintained during the reaction. Space-time yields of 1.0-1.5 pounds acrylonitrile per hour-foot^3 solution are obtained. The catalyst has a life of 1-2 months after which it must be regenerated.

The reaction pressure is slightly above atmospheric, sufficient pressure head being maintained to cause gas flow through subsequent separation equipment.

The reaction products pass to an absorber, the lean gas from which contains acetylene and divinylacetylene. The latter constituent is removed in a separate scrubbing operation. The residual acetylene is recycled through a blower to the reactor charge.

The absorber is operated at a water rate such that a two percent acrylonitrile solution is withdrawn as bottoms. This stream is sent to the stripper, from which a crude acrylonitrile-water azeotrope is taken overhead. The water layer from the separated azeotrope is recycled to the stripper feed. The oil layer, or "crude acrylonitrile," is sent to a distillation train for separation and purification.

The crude acrylonitrile contains, in order of decreasing volatility:

acetylene
monovinylacetylene
acetaldehyde
hydrogen cyanide
chloroprene
water-acrylonitrile azeotrope
acrylonitrile
divinylacetylene
1-cyanobutadiene
lactonitrile.

The concentration of acrylonitrile is about 80 weight percent; that of the other materials is four weight percent or less.

The first tower in the distillation train (light ends column) enables the overhead removal of materials boiling below acrylonitrile. Acetylene and monovinylacetylene pass off as gases. They may, if desired, be returned to the recycle gas scrubber. The water-acrylonitrile azeotrope is handled separately in a side-drawoff operation.

Product acrylonitrile, having a purity of about 99.5 percent on a dry basis, is removed as overhead from the second column. The operating head pressure is about 140 mm Hg abs. The bottoms stream contains heavy ends plus a significant amount of acrylonitrile.

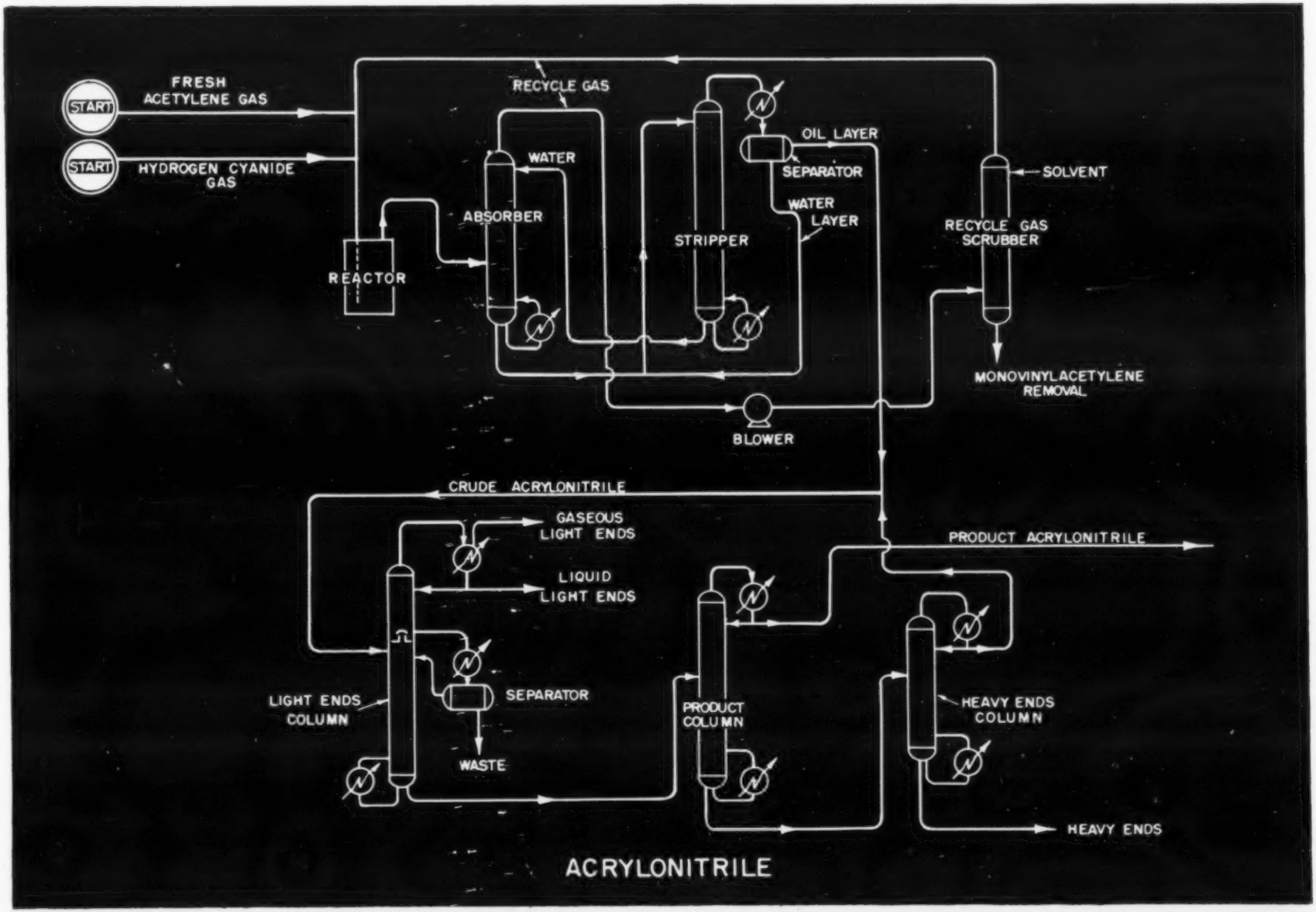
The third tower in the train, the heavy ends column, serves to recover acrylonitrile from the product column bottoms. The heavy ends column operates at a head pressure of 120-150 mm Hg abs. The recovered acrylonitrile is not specification-grade and must be recycled to the light ends column. The bottoms stream from the heavy ends column contains primarily 1-cyanobutadiene and lactronitrile, and is discarded.

The product acrylonitrile has a boiling range of 169-173 F. It is stored conventionally, and is shipped from the plant in tank cars.

OPERATING CONDITIONS: The important operating conditions are those in the reactor. They are defined in the above text.

YIELDS: Typical over-all process yields are:
Acrylonitrile from HCN, 85 percent.
Acrylonitrile from C_2H_2, 75 percent.

COMMERCIAL INSTALLATIONS: Plants utilizing the methane process are: Monsanto Chemical Company, Texas City, Texas; American Cyanamid Company, Fortier, La. (under construction); The B. F. Goodrich Company, Calvert City, Ky. (announced).


START
FRESH ACETYLENE GAS
START
HYDROGEN CYANIDE GAS
RECYCLE GAS
WATER
ABSORBER
REACTOR
STRIPPER
OIL LAYER
SEPARATOR
WATER LAYER
SOLVENT
RECYCLE GAS SCRUBBER
MONOVINYLACETYLENE REMOVAL
BLOWER
CRUDE ACRYLONITRILE
GASEOUS LIGHT ENDS
LIQUID LIGHT ENDS
PRODUCT ACRYLONITRILE
LIGHT ENDS COLUMN
SEPARATOR
WASTE
PRODUCT COLUMN
HEAVY ENDS COLUMN
HEAVY ENDS
ACRYLONITRILE

Direct Oxidation of Propane-Butane CELANESE CORPORATION OF AMERICA

Chemcel Plant

APPLICATION: This process is for the production of a number of organic aliphatic oxygenated chemicals and some derivatives from these chemicals.

CHARGE: Propane and butanes are consumed principally, although some other hydrocarbons would be permissible.

PRODUCTS: The products are acetic acid, acetaldehyde, formaldehyde in various forms and mixtures with other materials, acetone, alcohols, esters, several glycols and mixtures of alcohols or ketones designated as solvents.

DESCRIPTION: The Chemcel operation, which is continuous, starts with separate compression of air and the specified hydrocarbon gases, an excess being used of hydrocarbons to aid in controlling subsequent reactions. The separate gas streams are united and fed to the oxidation furnace where partial oxidation of the hydrocarbons in the gas stream occurs. This primary oxidation is effected in a group of identical furnaces, operated in parallel, which provide for preheating the mixture as well as suitable conditions for the reaction. After brief residence in the furnaces, the gas stream, which has become enriched with primary products formed in the hot reaction chambers, is quenched and absorbed in towers containing water. Vented from these absorbers are unreacted hydrocarbons, which are recycled to the compressors for re-use, and nitrogen under pressure which can be used for driving turbines.

At this stage, a separation of the crude water-chemical mixture is effected. Dilute formaldehyde is isolated first and is subsequently concentrated to the usual water solution known as formalin. Some of the formalin is processed, essentially by dehydration, to yield paraformaldehyde and trioxane.

The portion of the water-chemical mixture remaining after formaldehyde removal is subjected to appropriate procedures for separating and purifying the various chemical components consisting largely of alcohols, aldehydes, ketones and oxides. Chemicals emerging from this step are then ready either for marketing or for additional chemical processing to produce up-graded materials.

These advanced processing steps include secondary oxidation, hydrogenation and esterification. In these steps, techniques are employed involving simple and azeotropic distillations, fractionation, solvent-type extraction, evaporation, absorption and other unit processes.

OPERATING CONDITIONS: These do not for the most part involve extremes, but rather entail careful control of pressures, temperatures, rate of feed, catalyst and air-hydrocarbon ratios.

YIELDS: The operations are inherently flexible in that process equilibria can be controlled to the extent of allowing significant changes to be made in the outputs of the various chemicals.

COMMERCIAL INSTALLATION: This plant has been in production since 1945 and is located near Bishop, Texas.

Pampa Plant

APPLICATION: This process is for the manufacture of various organic aliphatic oxygenated chemicals.

CHARGE: The charge is primarily normal butane, although some higher hydrocarbons and propane can be tolerated.

PRODUCTS: The principal products are acetic acid and acetic anhydride. Other products are vinyl acetate, acetaldehyde, acetone, methanol, and propionic and butyric acids.

DESCRIPTION: Compressed air and butane are fed to vessels where the oxidation of the hydrocarbons takes place. The reaction-product mixture is run through coolers, including a battery of air-type heat exchangers, and then to separators where nitrogen and other gases are released. As this nitrogen is under considerable pressure, it is used to drive turbines in the process. The other components of these gases are the unreacted hydrocarbon material which is recycled to the reactors.

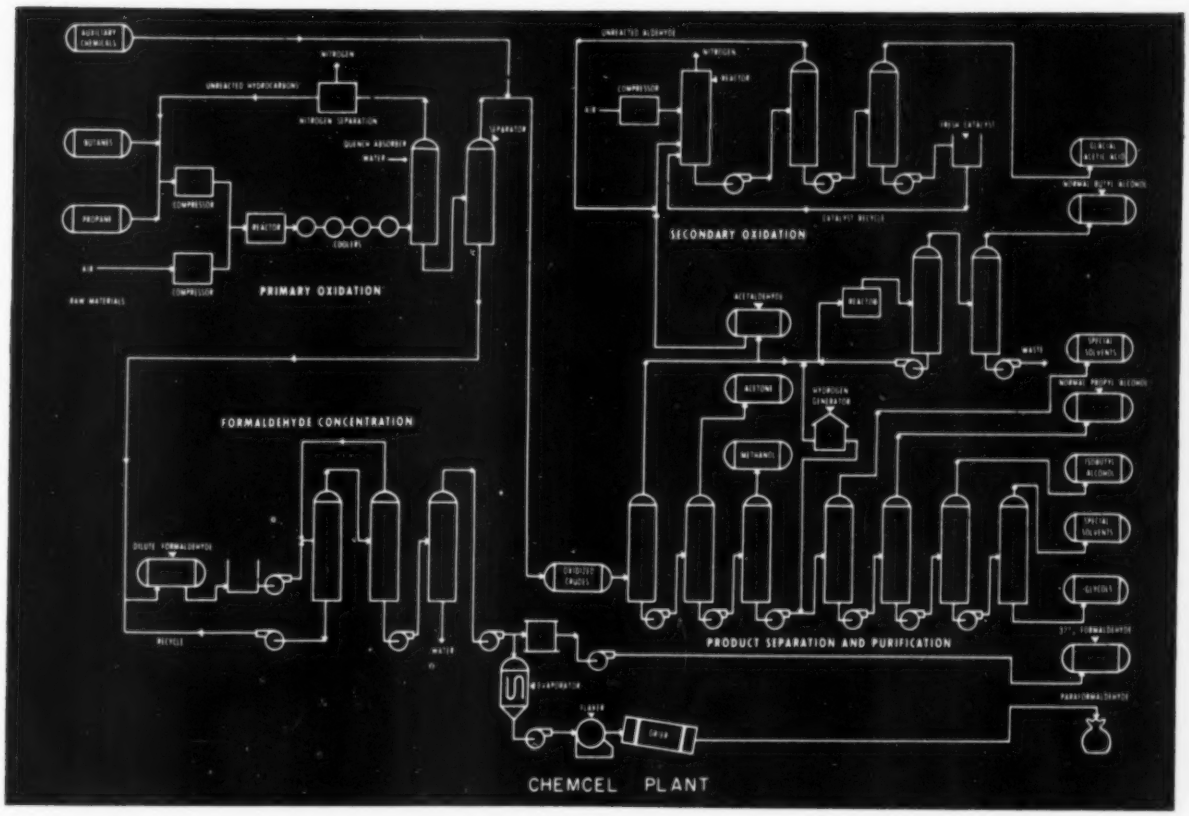
The liquid extract, or oxidized crude, is processed further to effect a separation of the relatively low boiling components. These low boiling components are the major product, acetic acid, and higher boiling materials. The acetic acid, after being separated from the oxidized crude mixture is fed to the anhydride unit, which has the capacity for high-efficiency conversion of all acetic acid produced (design capacity 1,300,000 pounds per week) to acetic anhydride. Also at this end of the plant is the new vinyl acetate unit, which has design capacity for production of more than 30 million pounds a year.

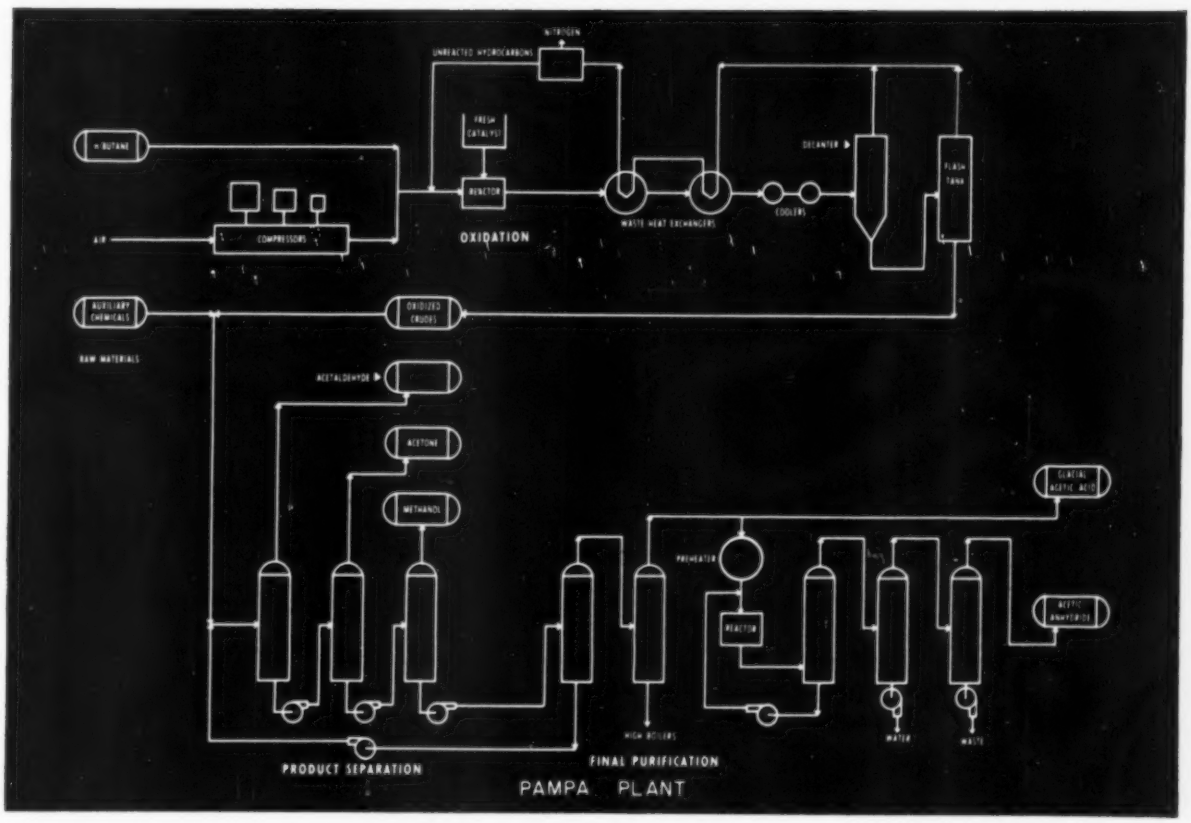
In addition to the main process equipment, a "utility" or "special products" unit is provided. This unit is comprised mainly of reaction and storage tanks and two large fractionating towers together with necessary auxiliary facilities. It is designed for either batch or continuous production and can operate both on co-products from the principal process streams and on large volume specialty products.

In addition to adopting a modified version of the basic process used in the Chemcel plant, a number of changes were made in equipment design. Perforated plate or sieve-type process columns are standard for the plant. Sieve trays were used because they were less expensive initially and are very satisfactory as to operating flexibility, ease of control and quality of product.

Another difference in design of the two plants is the use of air-cooled heat exchangers which are used to handle approximately 80 percent of the total cooling load at Pampa. This reduces the plant's dependence upon the vagaries of the weather in providing water for cooling purposes as the plant is situated in a region of scanty rainfall.

COMMERCIAL INSTALLATION: This plant has been operating at a location about 6 miles from Pampa, Texas, since late in 1952.


PRIMARY OXIDATION
SECONDARY OXIDATION
FORMALDEHYDE CONCENTRATION
PRODUCT SEPARATION AND PURIFICATION
CHEMCEL PLANT


OXIDATION
PRODUCT SEPARATION
FINAL PURIFICATION
PAMPA PLANT

Isopropyl Alcohol

STONE & WEBSTER - BADGER

APPLICATION: A process for manufacturing isopropyl alcohol.

CHARGE: Liquid propylene. A feed of 90 percent purity or better is desirable to minimize the handling of waste gas, although much lower concentrations of propylene can be handled satisfactorily.

PRODUCT: The product is a solution of 87 weight percent isopropyl alcohol.

DESCRIPTION: The liquid propylene feed stock, combined with recycled hydrocarbons, is first absorbed in 75 percent sulfuric acid in a series of agitated reactors to form a solution of diisopropyl sulfate and isopropyl acid sulfate. The sulfated hydrocarbon solution is converted to an acid solution of isopropyl alcohol, ether and polymer by hydrolysis reactions which take place in the hydrolyzer-stripper in the presence of dilution water. These reaction products are steam stripped from the acid in the same column and leave as overhead vapors. The vapors are neutralized by contact with caustic solution and then condensed. The condensate referred to as crude isopropyl alcohol, and consisting of alcohol, ether and polymer, is sent to an ether column for ether separation.

Spent sulfuric acid is pumped to an acid concentration plant not shown on the flow diagram for concentrating to 75 percent strength and reuse.

The crude isopropyl alcohol is charged to the ether column. The overhead vapors from this column, when condensed, will normally separate into two liquid layers, but the bulk of this condensate is refluxed to the column unseparated. A portion of the liquid is diverted from the main reflux stream and sent to a decanter for this separation. In the decanter the two liquid layers are separated and the upper layer, which is very rich in ether, contains only small proportions of alcohol and water, and the lower layer contains mainly water and small amounts of ether and alcohol. The lower water-rich layer is decanted from the upper layer and is refluxed back to the tower continuously along with the main reflux stream going to the column. The ether-rich layer, called recycled ether, is pumped back into the reaction system.

The liquid containing the bulk of the isopropyl alcohol, polymer and water, is pumped to the isopropyl alcohol column for recovery of the main product. The condensed overhead from this column is the 87 percent solution of isopropyl alcohol in water. Polymer is withdrawn as a side stream from the column and pumped to storage. From the base of the isopropyl alcohol column, water is withdrawn containing only traces of alcohol. This water is reused in the hydrolyzer-stripper.

OPERATING CONDITIONS: The propylene sulfation occurs in the reactors at 300-400 psig. All other equipment, except for the propylene feed tank, operates at near atmospheric pressures. No mechanical refrigeration is required.

YIELDS: High yields of isopropyl alcohol from propylene are achieved, the propylene lost in the tail gas or as polymer being about 5 percent on the propylene charged. All of the ether is subjected to sulfation and recycled to extinction.

COMMERCIAL INSTALLATIONS: This process is based on development work carried out by the Distillers Company, Ltd. A large commercial plant has been in operation for more than a year in the United Kingdom.

Methyl Ethyl Ketone and Acetone

APPLICATION: This process is for the manufacture of methyl ethyl ketone (MEK).

CHARGE: A mixture of normal butylenes.

PRODUCT: The product is methyl ethyl ketone (99 percent purity).

DESCRIPTION: Gaseous butylenes are charged to the absorption tower which operates at pressures slightly above atmospheric and at a temperature of 110 F. Sulfuric acid (about 80 percent) is fed to the top of the tower and reacts with the butylenes to form butyl sulfates. The reaction is exothermic, and cooling water is circulated through plate coils for heat removal.

Conversion of butylenes is practically complete. Inerts and unreacted light hydrocarbons are removed at the top of the column. The mixture of acid and butyl sulfates flows to hydrolyzer where it is contacted with a measured amount of water. The effect is to form alcohols from the sulfates. *Sec*-butyl alcohol is the principal product.

The hydrolyzate is fed to the acid stripper where, with the aid of live steam, alcohols are separated from the acid. Entrained acids in the alcohol stream are removed in a dilute (8-10 percent) caustic scrubber. The scrubbed vapors are condensed. The crude contains 10-20 percent water, light organics, *sec*-butyl alcohol and heavier organics.

The major problem in the purification is the separation of the *sec*-butyl alcohol from water. This is done in a tower to which an entrainer material, such as diisobutylene, is added. The entrainer forms light-boiling ternary azeotropes with the impurities and water. These azeotropes are taken overhead. *Sec*-butyl alcohol is separated from the heavy ends in the heavy ends column.

The *sec*-butyl alcohol (which will be referred to as "alcohol") is vaporized and fed to a mixing tank where it is combined with a small amount of air. The mixture, at 250-300 F., is heated to 750 F. and fed to the reactor.

The reactor contains a number of small-diameter tubes packed with supported zinc oxide catalyst. The reaction is exothermic, but the maximum temperature allowed is about 1000 F. The effect of this operation is a combined oxidation-dehydrogenation of the alcohol to MEK.

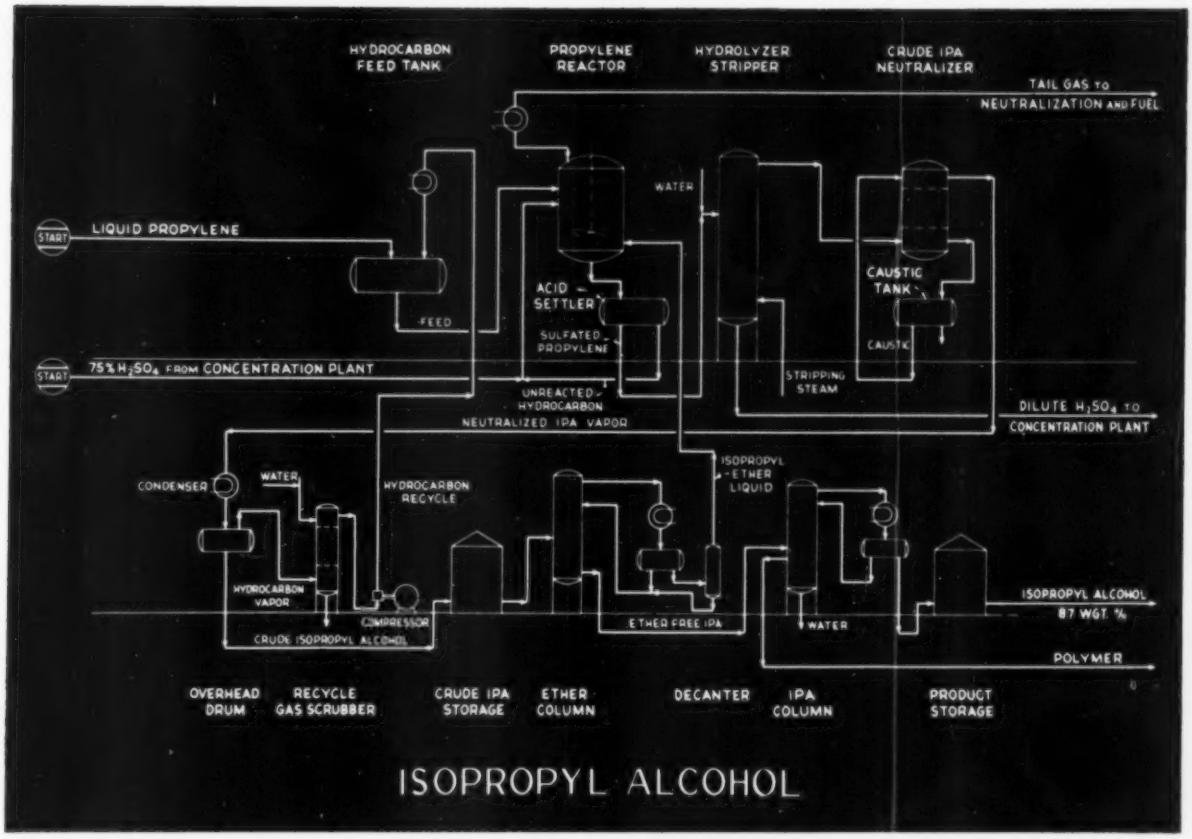
The reactor effluent contains MEK, unconverted alcohol, hydrogen and other fixed gases. The mixture passes through a preheater and a brine-cooled condenser. Equilibrium amounts of MEK and alcohol remaining in the vapor are recovered in a separate column by absorption in a non-volatile solvent.

The combined liquid streams from condenser and scrubber are fed to a fractionator where MEK with a minimum purity of 99.0 weight percent is removed overhead.

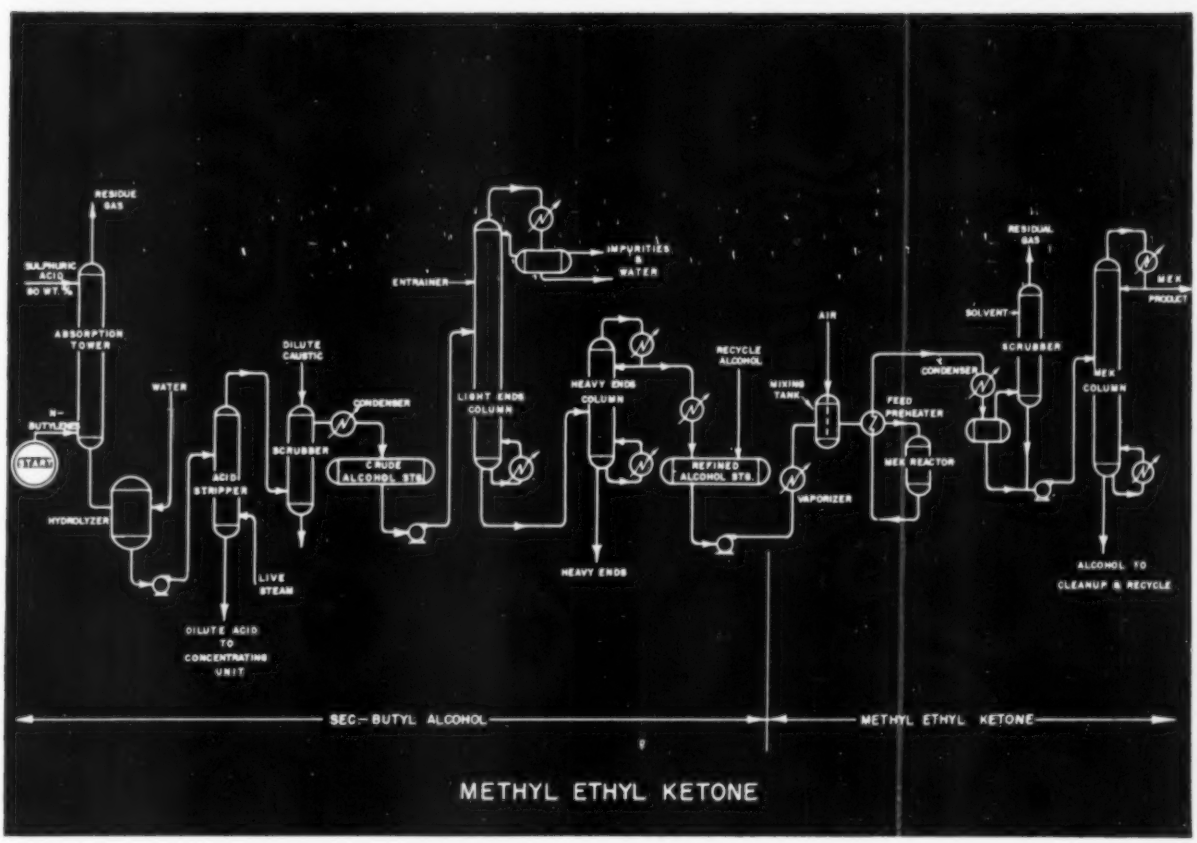
ACETONE: Acetone is made primarily from isopropyl alcohol by a similar combined oxidation-dehydrogenation reaction such as described above.

YIELDS: Over-all process yield, MEK from butylene, is 75-80 percent.

COMMERCIAL INSTALLATIONS: This process or a variation is used for making MEK at the following plants: Esso Standard Oil Company, Linden, N. J.; Shell Chemical Company, Deer Park, Texas, Martinez, Calif. and Dominguez, Calif.; Stanolind Oil Gas Company, Brownsville, Texas.



ISOPROPYL ALCOHOL



METHYL ETHYL KETONE

Propylene Tetramer

UNIVERSAL OIL PRODUCTS COMPANY

APPLICATION: A process to polymerize C_3 olefins for the production of tetramer.

CHARGE: Propane-propylene fraction.

PRODUCT: C_{12} polymers, C_{12}, polymers, light motor polymer and propane LPG.

DESCRIPTION: The charge to the polymerization unit, which consists of propane-propylene, should be treated for the removal of hydrogen sulfide and basic nitrogen compounds before being charged to the catalyst section. The hydrogen sulfide removal is generally accomplished by treatment with caustic, although any other suitable method may be employed.

The removal of basic nitrogen compounds from the poly plant feed can be accomplished by the contact of the hydrocarbon stream with fresh clean water in a countercurrent wash tower. In those cases where fresh clean wash water of the desired pH is not available in quantities sufficient to provide adequate water washing of the feed, economy in the use of water can be obtained by recirculating water and controlling pH of wash water by the injection of acid. With such a system, water makeup is reduced to that required to keep the wash water reasonably low in inorganic salt content.

Following the water washing operation the charge flows to a combined feed surge drum.

The charge pump takes suction from the surge drum and discharges the feed to the catalyst section which consists of beds of solid phosphoric acid catalyst. The temperature of the reaction is controlled by introducing a low olefin content stream from the fractionation section as quench between the catalyst beds.

The fractionation section consists of a depropanizer, recycle column and rerun column. These towers and their auxiliaries may be conventional in design, the net products being propane LPG, motor polymer, tetramer and tetramer bottoms. In the fractionation system the depropanized polymer product is separated into recycle and crude tetramer by the recycle column. Part of the recycle is continuously withdrawn as motor polymer.

A portion of the propane-propylene is made available as quench material to be used for the purpose of controlling the catalyst temperatures in the catalyst chambers. The net propane-propylene may be pumped as a liquid to LPG storage or used directly as fuel gas.

The recycle column controls the initial boiling point of the tetramer product. The overhead is recycled back to the combined feed surge drum, with all excess overhead being pumped to motor poly storage or to blended gasoline storage. If polymer is stored separately it should be inhibited on the way to storage. If stored as a blend with other products, one of the streams should contain enough inhibitor so that the minimum concentration exists in the tank at all times.

Because of the high reboiler temperature on the rerun column, operations are usually carried out under vacuum. The bottoms product is normally quite small and is designed to be pumped out only periodically on hand control.

YIELDS:

Fresh Feed:	Vol. Percent	Products:	Vol. Percent
Propylene-Propylene	100.0	Tetramer 350–480 F	24.5
		Heavy Polymer 480 F.-E.P.	0.5
		Light Polymer I.B.P.-350 F.	10.0
		Propane LPG	65.0
			100.0

COMMERCIAL INSTALLATIONS: There are 13 units in operation at the present time.

Isobutylene Extraction

STANDARD OIL DEVELOPMENT COMPANY

APPLICATION: A process for the extraction of isobutylene.

CHARGE: A stream containing 10 to 35 weight percent isobutylene, mixed with n-butylenes and varying amounts of saturated hydrocarbons.

PRODUCT: The product is 96+ percent purity isobutylene.

DESCRIPTION: The principal steps in the process are shown in the accompanying flow diagram. The feed is charged to a reactor where it is contacted with 65 percent sulfuric acid. The acid strength is important because at this strength the acid does not absorb the other components to any appreciable extent. The isobutylene is absorbed by the acid, and an emulsion is formed. The reaction is highly exothermic and the temperature within the reactor must be closely controlled to prevent excessive absorption of the other components. Generally this temperature is controlled around 100 F. which requires the use of refrigeration.

From the reactor the emulsion goes to a settler where the spent C_4 hydrocarbons are separated from the isobutylene-acid extract. The extract is removed from the bottom of the settler and is sent to the regenerator.

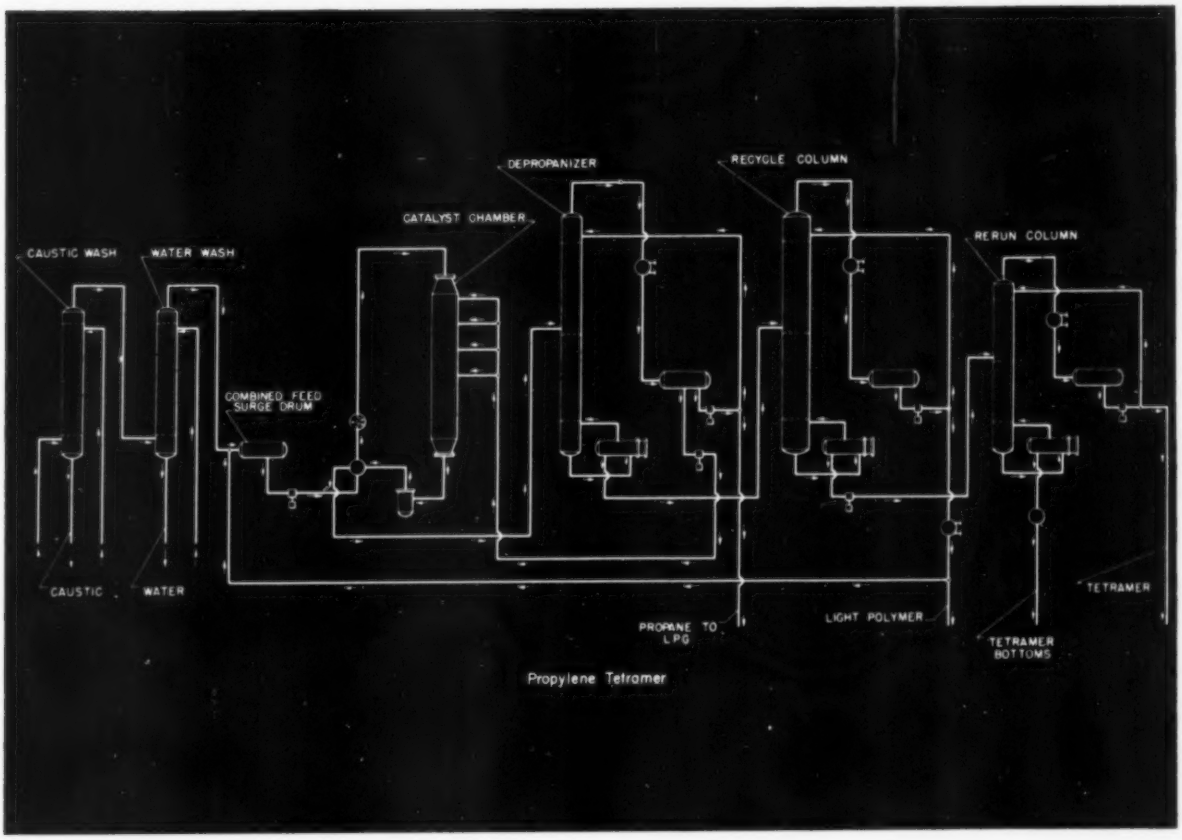
In the regenerator the isobutylene is separated from the acid with steam. The acid, which has become diluted in the process, goes to the reconcentrator where its strength is built up to 65 percent using a steam coil which evaporates a portion of the water in the acid. It is then returned to the extraction step.

The regenerated isobutylene from the steam stripping operation is washed with caustic to remove traces of acidic impurities and to hydrolyze and then neutralize any esters that were formed in the process. Caustic washing is followed by water washing to remove any excess caustic.

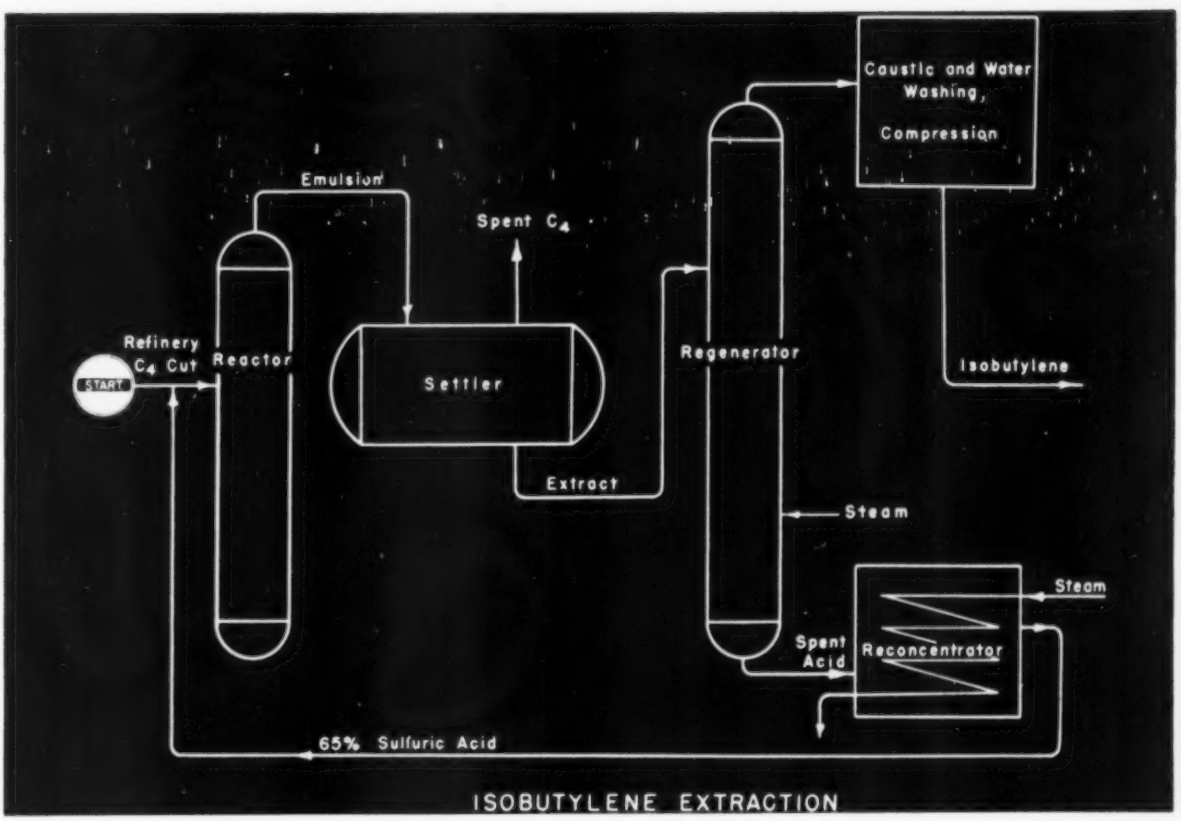
Isobutylene from the water washing step is fed to a fractionator where the high-boiling materials formed in the process are removed. The purified isobutylene is then compressed, condensed and delivered to storage.

OPERATING CONDITIONS: The major operating conditions are given in the text.

YIELDS: Both the percentage recovery and the purity of the product depend on the composition of the feed stock, and on the precise operating conditions used in the isobutylene extraction process. For typical installations, the recovery will be in the range of 85 percent with a product purity of 96+ percent.



Propylene Tetramer



ISOBUTYLENE EXTRACTION

Butadiene from Butenes

STANDARD OIL DEVELOPMENT COMPANY

APPLICATION: A process for the catalytic dehydrogenation of normal butenes to butadiene-1,3.

CHARGE: A C_4 hydrocarbon stream containing about 80 weight percent n-butenes.

PRODUCT: A crude butadiene stream from which high purity butadiene can be extracted.

DESCRIPTION: The feed is preheated to about 1000 F. in the hydrocarbon superheater. The hot gases are then mixed with superheated steam and the mixture is passed through the fixed-bed catalyst. The low partial pressures neccessary for the dehydrogenation of the butenes to butadiene by the catalyst are obtained by the use of this steam. Carbon deposited in the catalyst is removed by the "water gas reaction" with steam, partially during the dehydrogenation and partially during the regeneration cycle.

The hot gases leaving the reactor go through steam generators where they are cooled and where some of the steam for the process is generated. The gases are then fed to the oil quench tower. After additional cooling, the gases go to the water quench tower. From the water quench tower the gases go through a vapor separator where liquid is removed and then go to the compressors.

After compression the gases are cooled and then fed to a series of three towers. In the first of these towers the C_4 hydrocarbons are absorbed in a light naptha cut while the C_3 and lighter hydrocarbons plus hydrogen and carbon monoxide and dioxide are removed overhead and used as fuel gas. The absorption of the hydrocarbons in the oil is exothermic, and the temperature throughout the tower must be carefully controlled to prevent either the absorption of excessive amounts of the light components or the loss of some of the C_4 fraction. This control can be accomplished by the use of intercoolers at various points down the tower. The absorption oil containing the C_4 hydrocarbons goes out the bottom and is fed to the second tower where the gases are stripped out of the absorption oil. Absorption oil is returned to the first tower.

The overhead stream from the second tower is fed to the rerun tower where the C_5 and heavier components are removed from the bottom of the tower. The overhead stream from this tower is the crude butadiene.

OPERATING CONDITIONS: The principal operating conditions are:

Space Velocity, V/H/V (Volume of n-butene as gas at standard conditions per hour per volume of catalyst)	125-225
Pressure Above Bed, psig	7-11
Pressure Below Bed, psig	2-4
Partial Pressure, mm Hg. (at reactor inlet)	60-80
Steam/Butene, Gas Volume Ratio	14-18
Temperature, F	1175-1225

YIELDS: Typical once-through yields* are as follows:

	Feed Weight Percent	Products Weight Percent
Normal Butenes	80.0	60.0
Butadiene	2.0	16.4
Other C_4's	18.0	16.0
Polymer	....	1.0
Fuel Gas and Coke	....	6.6

* Yields and operating conditions will depend upon the catalyst used.

Butadiene Extraction

STANDARD OIL DEVELOPMENT COMPANY

APPLICATION: A liquid phase selective solvent extraction process for recovering butadiene.

CHARGE: A butane-butene-butadiene cut produced by catalytic dehydrogenation of normal butenes or by high temperature cracking of naphtha or gas oil.

PRODUCT: Butadiene of 98.5+ percent purity.

DESCRIPTION: The three major components of the charge stream, butadiene, butanes and n-butenes, have close boiling points and it is necessary to use a solvent which will selectively absorb the butadiene. The solvent used is an aqueous ammoniacal cuprous acetate solution of this approximate composition:

	Mols/Liter	Weight Percent
Total Copper	3.3	17.5
Cuprous Copper	3.0	
Acetate (Acetic Acid)	4.0	20.0
Ammonia	11.0	15.5
Water	31.3	46.9
	....	100.0

In the absorber section, the stripper section and the rejection stage, the butadiene is contacted and absorbed by the solvent while the majority of the butanes and butenes are rejected from the system. The solvent is mixed with the hydrocarbon feed in a series of stages, each of which consists of a turbo mixer and a settler. The hydrocarbon not absorbed by the solvent is recycled back to other stages for additional contacting with the solvent until essentially all the butadiene is finally absorbed. The hydrocarbons that are rejected are water washed and then are recycled to the catalytic rehydrogenation plant or are diverted to alkylation plant feed.

The solvent containing the butadiene is fed to the desorber tower where the hydrocarbon stream is separated from the solvent. The hydrocarbon stream is sent to the butadiene scrubber where water washing removes solvent.

From the scrubber the butadiene stream goes to the butadiene rerun tower where enough of the other components are removed to bring the stream up to 98.5 + percent purity butadiene. This tower uses a flux oil to make the separation. After the addition of an inhibitor, the final product is sent to storage.

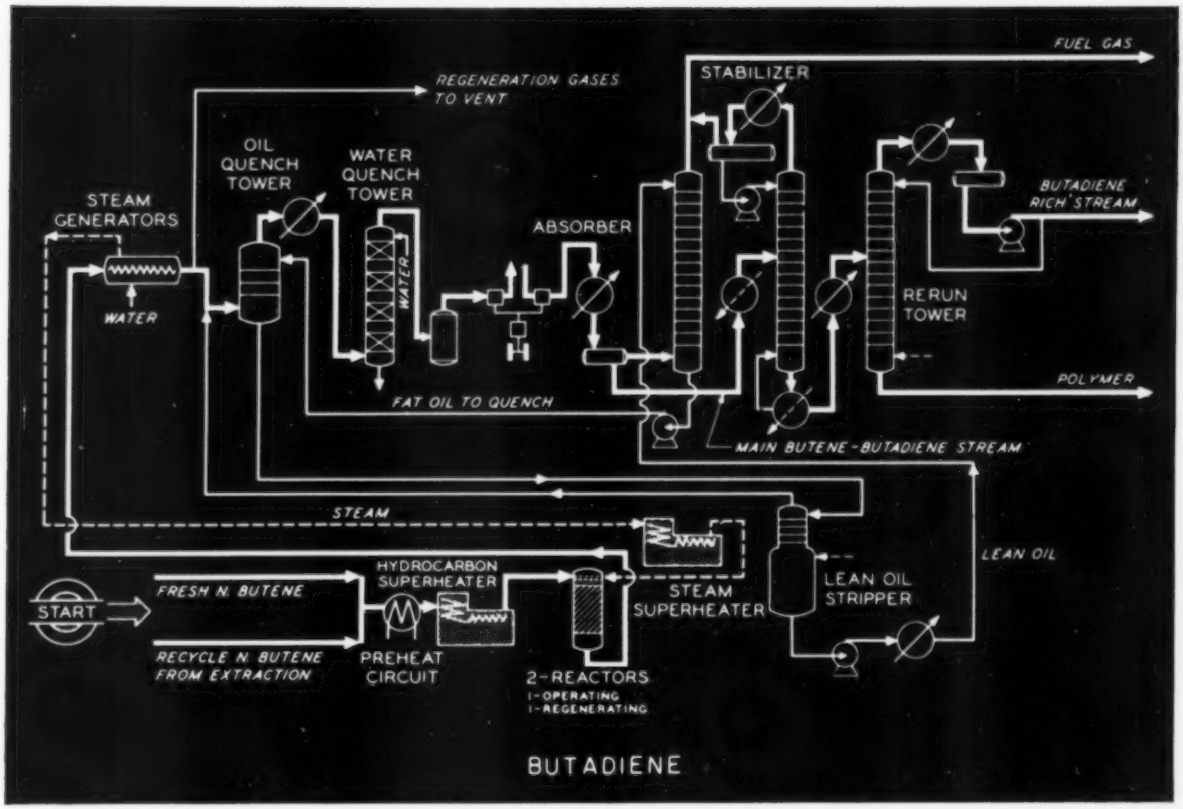
OPERATING CONDITIONS: The principal operating conditions are:

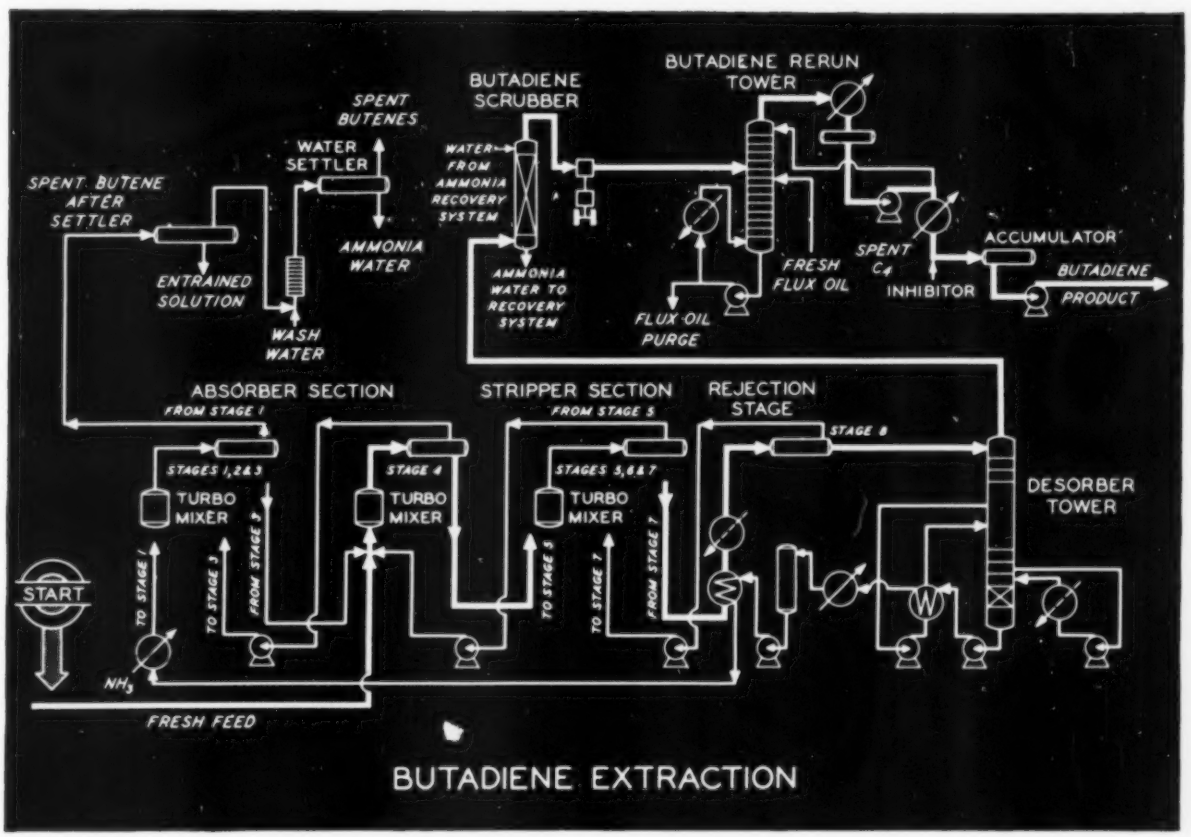
Ratio of Copper solution to Feed, lb./lb.	8.0
Lean Solution Temperature, F	8
Lean Solution Pressure, psig	45
Rejection Temperature, F	100
Desorber Bottom Temperature, F	175
Desorber Bottom Pressure, psig	15

YIELDS: Typical yields and analyses of the feed and products are as follows:

	Feed Mol. Percent	Spent Butenes Product, Mol. Percent	Butadiene Product, Mol. Percent
C_3	0.2	0.3	0.3
Butadiene	16.7	0.9	98.5 (Min.)
i-Butene	4.9	5.7	0.2
n-Butenes	62.8	75.1	1.0
Butanes	15.3	17.9	....
C_5	0.1	0.1	....
	100.0	100.0	100.0

Butadiene Recovery (percent of butadiene in feed)—95 percent.


FUEL GAS
REGENERATION GASES TO VENT
STABILIZER
OIL QUENCH TOWER
WATER QUENCH TOWER
STEAM GENERATORS
WATER
ABSORBER
BUTADIENE RICH STREAM
RERUN TOWER
POLYMER
FAT OIL TO QUENCH
MAIN BUTENE-BUTADIENE STREAM
STEAM
LEAN OIL
HYDROCARBON SUPERHEATER
START
FRESH N. BUTENE
STEAM SUPERHEATER
LEAN OIL STRIPPER
RECYCLE N. BUTENE FROM EXTRACTION
PREHEAT CIRCUIT
2-REACTORS
1-OPERATING
1-REGENERATING
BUTADIENE


BUTADIENE RERUN TOWER
BUTADIENE SCRUBBER
SPENT BUTENES
WATER SETTLER
WATER FROM AMMONIA RECOVERY SYSTEM
SPENT BUTENE AFTER SETTLER
AMMONIA WATER
ENTRAINED SOLUTION
AMMONIA WATER TO RECOVERY SYSTEM
FRESH FLUX OIL
SPENT C4 INHIBITOR
ACCUMULATOR
BUTADIENE PRODUCT
FLUX OIL PURGE
WASH WATER
ABSORBER SECTION
STRIPPER SECTION
REJECTION STAGE
FROM STAGE 1
FROM STAGE 5
STAGE 8
STAGES 1,2&3
STAGE 4
STAGES 5,6&7
TURBO MIXER
TURBO MIXER
TURBO MIXER
DESORBER TOWER
START
TO STAGE 1
TO STAGE 3
FROM STAGE 3
TO STAGE 5
TO STAGE 7
FROM STAGE 7
NH3
FRESH FEED
BUTADIENE EXTRACTION

Amyl Alcohol

SHARPLES CHEMICALS INC.

APPLICATION: A process applied to the manufacture of amyl alcohols using amyl chloride manufacture as an intermediate step.

CHARGE: The charge materials are pentane and anhydrous chlorine.

PRODUCT: Amyl alcohols, mixed isomers; secondary, primary and tertiary amyl alcohols.

DESCRIPTION: Pentane is fed to the dehydration tank where it is contacted with hydrogen chloride gas. The gas removes the moisture from the pentane and is sent to a recovery unit. The acid formed is removed from the bottom of the tank and is put to the sewer. The anhydrous pentane is then fed to a vaporizer.

Anhydrous chlorine is fed to a vaporizer and then to a mixing chamber where it is mixed with the vaporized pentane. The pentane-chlorine is maintained above the explosive limit.

The mixture of the two gases goes to a pipe still where the reaction between the two is carried to completion. The gases enter the pipe still at about 120 C. and leave at about 300 C. The gases are sent immediately to a cooler to hold down the formation of dichloropentanes. An exposed-type cascade cooler is used so that leaks can be detected quickly.

From the cooler the gases go to a fractionating column where hydrogen chloride and unreacted pentane go overhead. The hydrogen chloride, after cooling, returns to the pentane dehydration tank and the condensed pentane is sent to the make-up tank.

The amyl chlorides, dichlorides and pentane from the bottom of this column go to the second column where pentane is taken overhead and recycled back to the first column. The bottom stream goes to the third column where amyl chloride and small amounts of pentane go overhead. Dichloropentanes are removed from the bottom of the column. The amyl chlorides and pentane go to the fourth column for final purification of the amyl chlorides.

The amyl chlorides (a mixture of primary, secondary and tertiary chlorides) are caustic washed to remove any residual hydrogen chloride and are then fed to the first digester. In this equipment the chloride is hydrolyzed to the alcohol. Oleic acid and enough caustic are added to the digester so that the sodium hydroxide concentration is about 3 percent at startup.

From this digester the mixture goes to a heater and on to a second digester. Sodium hydroxide concentration in the second digester is maintained at about 0.5 percent.

The alcohol mixture from the top of the second digester is cooled, and then separated from most of the water in the stream in a decanter. The water is processed for alcohol recovery.

In the first purification column, pentene is taken overhead. Amyl chloride, amyl alcohol and water are fed from the bottom of this column to the second column where amyl chloride is removed. The amyl chloride goes out the overhead and is recycled back to the digesters. In the final column, dehydration is accomplished by taking the water and some of the amyl alcohol overhead. The alcohol is decanted from the water and returned to the column as reflux. The crude amyl alcohol is the bottom stream from this column. This crude amyl alcohol goes to a batch still (not shown) where the necessary cuts are made. The product is then sent to storage.

Amyl Acetate

SHARPLES CHEMICALS INC.

APPLICATION: A process applied to the production of amyl acetate.

CHARGE: The charge consists of amyl alcohol and acetic acid.

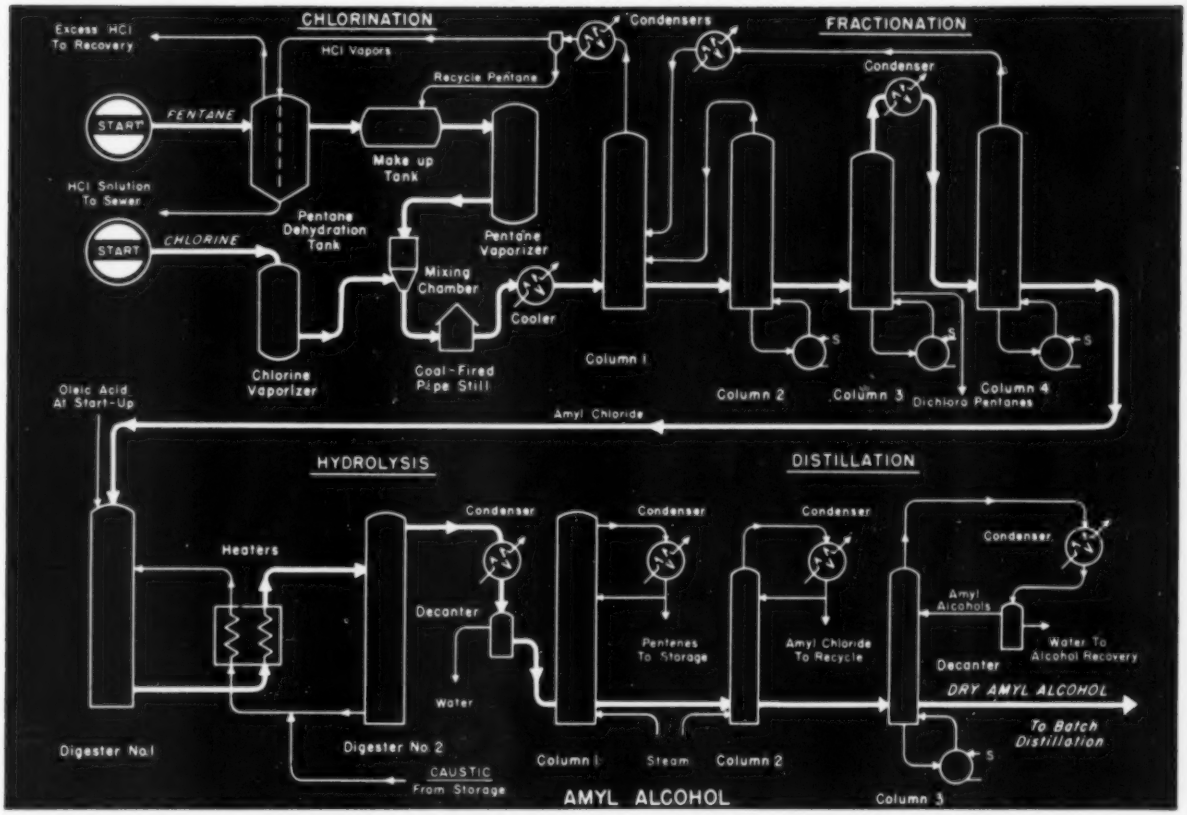
PRODUCT: The product is an amyl acetate of 86 percent minimum concentration.

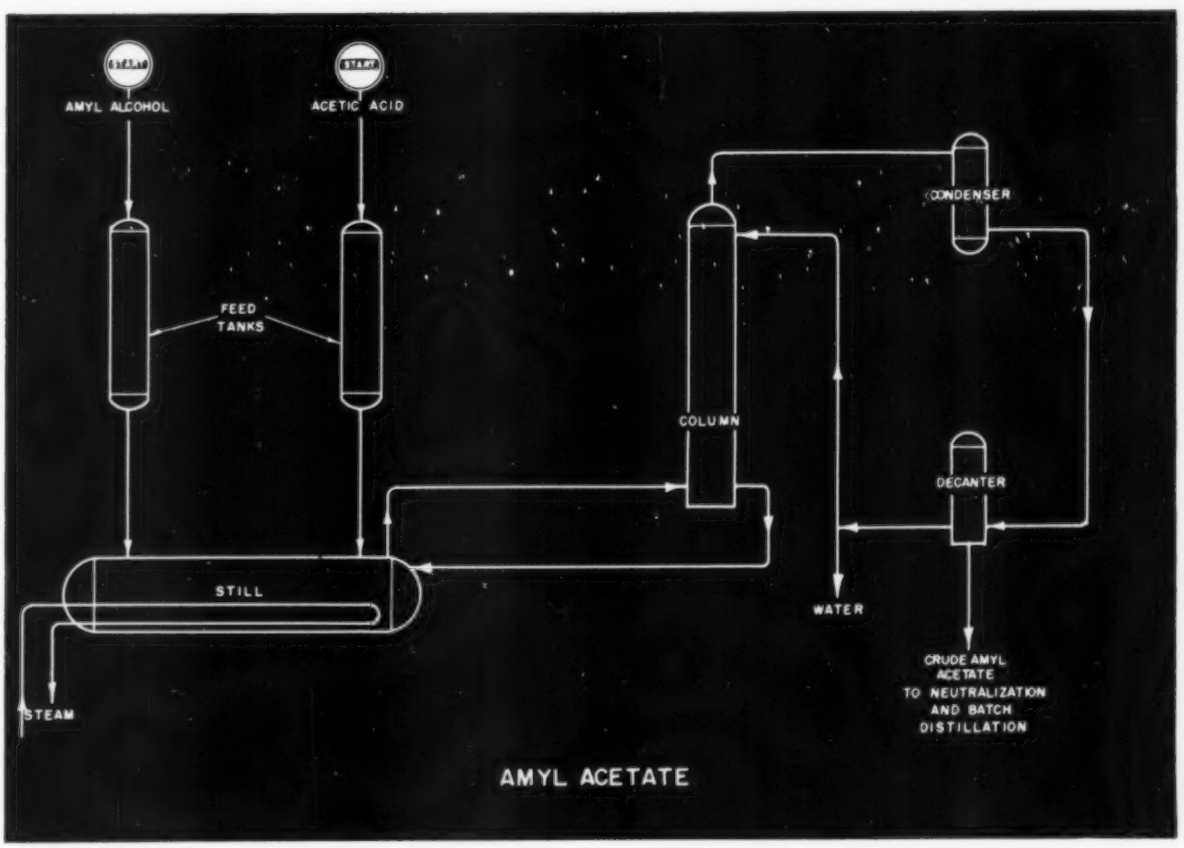
DESCRIPTION: Amyl alcohol and glacial acetic acid (approximate concentration, 99 percent) are charged into a reaction vessel. This vessel has a capacity of 4000 gallons and is of copper construction. Enough water is also charged to this still to make the acetic acid concentration about 40 percent in the total mixture. To this mixture is added two weight percent concentrated sulfuric acid.

The still is equipped with steam coils, and low pressure steam (about 40 to 60 pounds) goes through these coils to heat the mixture. Vapors from the still go to a copper distillation column. Initially the feed to the column contains about 5 percent acetic acid. The system is operated under total reflux until this acid concentration drops to 0.5 percent or less. At this point the column is put on forward flow, and the acetate is taken out the overhead. The reflux ratio is maintained at about 3:1. The liquid level in the still is maintained by the addition of amyl alcohol, and sufficient acetic acid is added to hold the acid concentration at 40 percent.

Overhead vapors from the column are condensed and then go to a decanter where water is removed. Some of both the water and the acetate are refluxed back to the column. The crude acetate from the decanter goes to surge.

From the surge tank the acetate is sent to the neutralizer where sodium carbonate is used to neutralize any acid material remaining in the acetate. Following neutralization, the product again goes to storage before being fed to the batch distillation step. A carbon steel bubble-cap column is used for this final distillation. A total of five cuts are made on the material fed to this step. The first contains primarily amylene which was formed during the process by decomposition. The second is water containing some crude acetate. This cut is fed to a decanter where the acetate is recovered. The third cut contains about 23 percent acetate in amyl alcohol. This stream is recycled to the acetylation step. The fourth cut contains about 60 percent acetate, and this cut is recycled back to the neutralizer. The fifth and final cut which constitutes the remainder of the material in the still contains about 87 to 88 percent acetate in amyl alcohol. This material is blended with sufficient amyl alcohol to give a consistent product of at least 86 percent amyl acetate in alcohol.


CHLORINATION
FRACTIONATION
Excess HCl To Recovery
HCl Vapors
Condensers
Condenser
Recycle Pentane
START
PENTANE
Make up Tank
HCl Solution To Sewer
Pentane Dehydration Tank
START
CHLORINE
Pentane Vaporizer
Mixing Chamber
Cooler
Chlorine Vaporizer
Coal-Fired Pipe Still
Column 1
Column 2
Column 3
Column 4
Dichloro Pentanes
Oleic Acid At Start-Up
Amyl Chloride
HYDROLYSIS
DISTILLATION
Condenser
Heaters
Decanter
Pentenes To Storage
Amyl Chloride To Recycle
Amyl Alcohols
Water To Alcohol Recovery
Decanter
DRY AMYL ALCOHOL
To Batch Distillation
Water
Digester No.1
Digester No.2
CAUSTIC From Storage
Column 1
Steam
Column 2
Column 3
AMYL ALCOHOL


AMYL ALCOHOL
ACETIC ACID
CONDENSER
FEED TANKS
COLUMN
DECANTER
STILL
WATER
STEAM
CRUDE AMYL ACETATE TO NEUTRALIZATION AND BATCH DISTILLATION
AMYL ACETATE

Phenol from Cumene

APPLICATION: A process for manufacturing synthetic phenol from cumene.

CHARGE: Cumene (isopropylbenzene), air, hydrogen, dilute sulfuric acid.

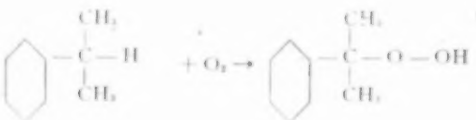
PRODUCTS: Phenol (42.5-43 °C m. p.), acetone, acetophenone.

DESCRIPTION: Raw material cumene is obtained from the alkylation of benzene with propylene over a phosphoric acid catalyst. The propylene is usually derived from the products of propane cracking. The cumene is fractionated to a high degree of purity before being charged to the phenol unit.

Fresh and recycle cumene in a ratio of about 1:4 are mixed and sent to the hydrogenator. The recycle cumene contains about one percent alpha-methylstyrene and this must be removed before the cumene is oxidized. Hydrogen gas is bled into the reactor and the alpha-methylstyrene is converted directly to cumene. A suspended nickel catalyst is employed, together with mechanical agitation and a temperature of about 210 F. The effluent liquid contains less than 50 ppm alpha-methylstyrene.

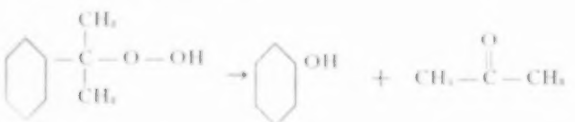
The purified cumene is decanted from the catalyst, filtered, and pumped to the oxidizer. Intermediate storage is provided in order to buffer flow surges.

The oxidizer is a vessel containing an agitated oil-water emulsion. The contents are maintained at 265 F. Emulsifying agents such as sodium stearate or sodium lauryl sulfate are used. Air is injected under the surface and supplies the oxygen for reaction. An excess of cumene is used in order to utilize a substantial portion of the oxygen in the air. Cumene hydroperoxide is produced according to the reaction:



About 25 percent of the cumene is converted per pass. The liquid effluent is separated from fixed gases and sent to the cleavage vessel.

In the cleavage step the peroxide is decomposed by boiling it under pressure in the presence of an acid. The reaction which occurs is:



The peroxide is completely decomposed. Dilute sulfuric acid is used and continuously recycled. The reactor effluent flows to a separator from which the oil layer, or crude phenol, is removed for further processing. The aqueous layer is recycled to the cleavage vessel.

Residual acid is removed from the crude phenol by countercurrent scrubbing with water in a packed tower. The washed oil has the following approximate composition:

	b.p., °F.	Weight-percent
Acetone	134	8
Cumene	307	76
Alpha-Methylstyrene	330	1
Phenol	359	14
Acetophenone	396	1
		100

Phenol, acetone, and acetophenone are of commercial importance and are separated individually. Alpha-methylstyrene has uses in plastics manufacture and in some cases is separated. In the process described here it is converted to cumene.

The crude phenol is pumped to a fractionating column which operates at atmospheric pressure. Acetone is separated as overhead product. The bottoms stream passes to the cumene tower. This tower operates under vacuum and removes cumene and alpha-methylstyrene as overhead product. These materials are recycled to the hydrogenator. At this point an additional fractionator may be employed for the purpose of separating alpha-methylstyrene.

The bottoms stream from the cumene tower contains about six percent acetophenone and the remainder essentially phenol. This material passes to the phenol tower, which also operates under vacuum. The product phenol passing overhead is condensed at about 120 F, and crystallized in a special receiver. The bottoms stream contains about 15 percent phenol and the remainder acetophenone.

The importance of this process is that it provides substitution on an aromatic ring without chlorinating or sulfonating. Thus chlorine and sulfuric acid, both of which are at times in short supply, are not needed. A very small amount of sulfuric acid is used as catalyst, as mentioned above, and other acids, such as phosphoric, may be substituted for it.

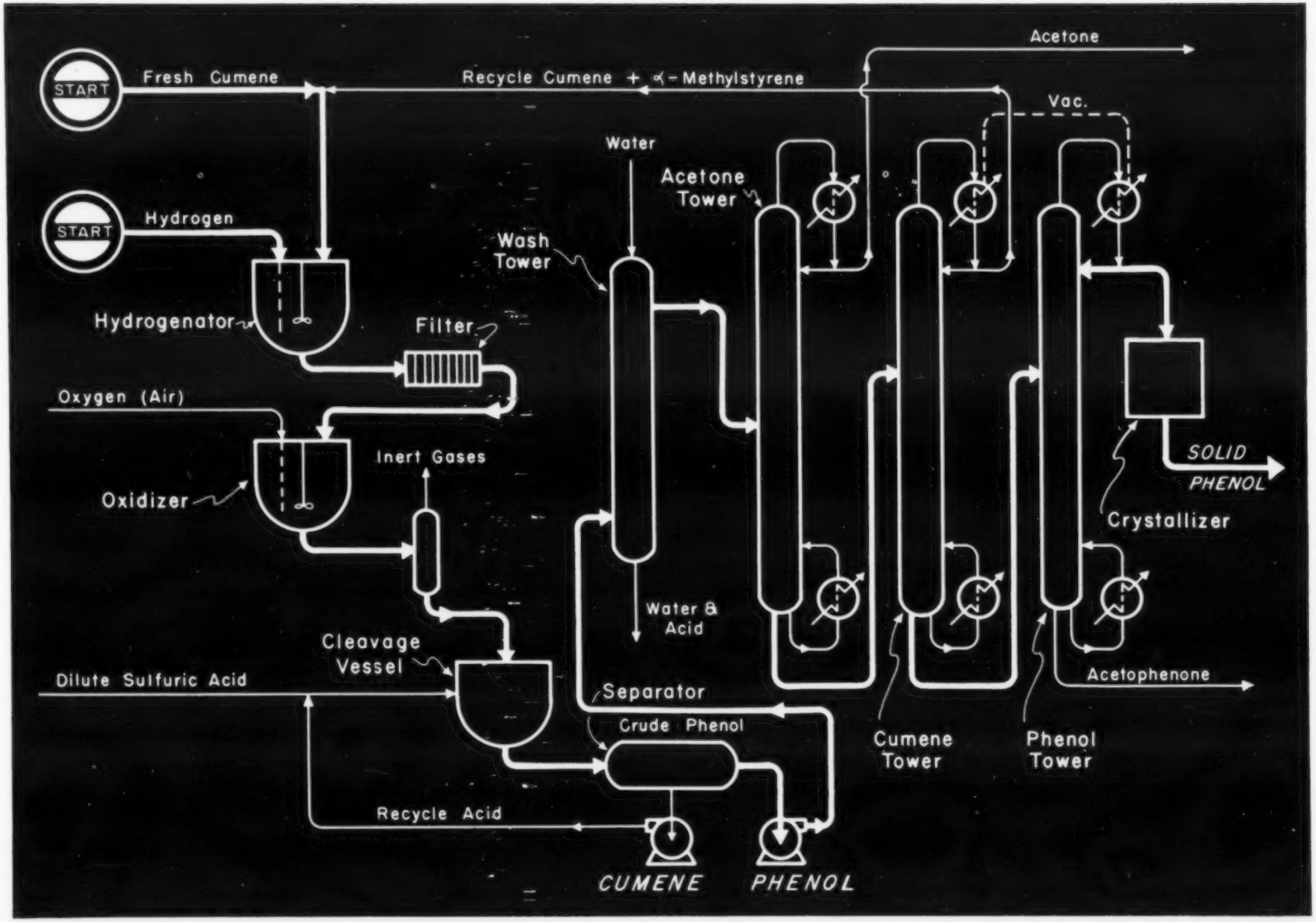
Another important feature of this process is that substantial quantities of acetone are produced. The credit for this valuable by-product strongly influences the economics of the process.

OPERATING CONDITIONS: The principal conditions for the oxidation and cleavage steps are given in the above text.

YIELDS: The over-all process yield, from raw material cumene to finished phenol, is about 93 percent of theory.

COMMERCIAL INSTALLATIONS: British American-Shawinigan, Ltd., Montreal East, Canada; Barrett Division of Allied Chemical and Dye Corporation, Frankford, Pa. (under construction); Hercules Powder Company, Gibbstown, N. J. (under construction); Oronite Chemical Company, Richmond, Calif. (under construction).

Editor's Note: Although this is the newest major commercial process for manufacturing phenol, there are three other processes. These are the phenol by sulfonation, the phenol from chlorobenzene and the Raschig process. The phenol by sulfonation is presented in this section.


START
Fresh Cumene
Recycle Cumene + α-Methylstyrene
Acetone
Vac.
START
Hydrogen
Water
Acetone Tower
Wash Tower
Hydrogenator
Filter
Oxygen (Air)
Inert Gases
Oxidizer
SOLID PHENOL
Crystallizer
Water & Acid
Cleavage Vessel
Dilute Sulfuric Acid
Separator
Acetophenone
Crude Phenol
Cumene Tower
Phenol Tower
Recycle Acid
CUMENE
PHENOL

Cumene

UNIVERSAL OIL PRODUCTS COMPANY

APPLICATION: A process for alkylating propylene and benzene.

CHARGE: Propane-propylene and benzene.

PRODUCT: Isopropyl benzene (cumene), heavy aromatics, and propane LPG.

DESCRIPTION: The propane-propylene charge to the Cumene unit should be treated for the removal of hydrogen sulfide and basic nitrogen compounds before being charged to the catalyst section. The hydrogen sulfide removal is generally accomplished by treatment with caustic, although any other suitable method may be employed.

The removal of basic nitrogen compounds from the poly plant feed can be accomplished by the contact of the hydrocarbon stream with fresh clean water in a countercurrent wash tower. In those cases where fresh clean wash water of the desired pH is not available in quantities sufficient to provide adequate water washing of the feed, economy in the use of water can be obtained by recirculating water and controlling pH of wash water by the injection of acid. With such a system water makeup is reduced to that required to keep the wash water reasonably low in inorganic salt content.

Following the water washing operation, the propane-propylene charge flows to a combined feed surge drum where it combines with benzene.

The combined propane-propylene and benzene is then charged through suitable heat exchange to the catalyst section. The alkylation reaction is carried out using solid phosphoric acid catalyst under controlled conditions of temperature and pressure.

The effluent from the reaction zone flows to the fractionation section of the Cumene unit, which consists of a depropanizer, benzene column, and rerun column. These towers and their auxiliaries may be conventional in design, the net products being propane LPG, benzene drag stream, rerun cumene and cumene bottoms.

From the depropanizer a portion of the propane-propylene is made available as quench material to be used for the purpose of controlling the temperatures in the catalyst chambers. The net propane-propylene may be pumped as a liquid to LPG drying and storage or used directly as fuel gas.

The depropanized product is separated into recycle and crude cumene by the benzene column. A small part of the recycle is periodically withdrawn as a drag stream to remove contaminants.

The benzene column controls the initial boiling point of the cumene product. The benzene overhead stream from this column is recycled along with fresh benzene to the combined feed drum, and the bottoms are charged to the rerun column, where cumene is separated from higher boiling aromatics.

YIELDS:

Fresh Feed:	Vol. Percent	Products:	Vol. Percent
Propane-propylene	69.0	Propane LPG	43.5
Benzene	31.0	Rerun Cumene	53.5
		Bottoms	3.0
	100.0		100.0

COMMERCIAL INSTALLATIONS: Eight units were operating during the World War II period. Since that time one new unit has been placed in operation.

Phenol by Sulfonation

MONSANTO CHEMICAL COMPANY

APPLICATION: A process for the manufacture of phenol from benzene by the sulfonation process.

CHARGE: Benzene, sulfuric acid and caustic soda are the charge.

PRODUCT: Phenol USP; by-products: sodium sulfite, sodium sulfate, sulfur dioxide.

DESCRIPTION: The reactions involved are as follows:

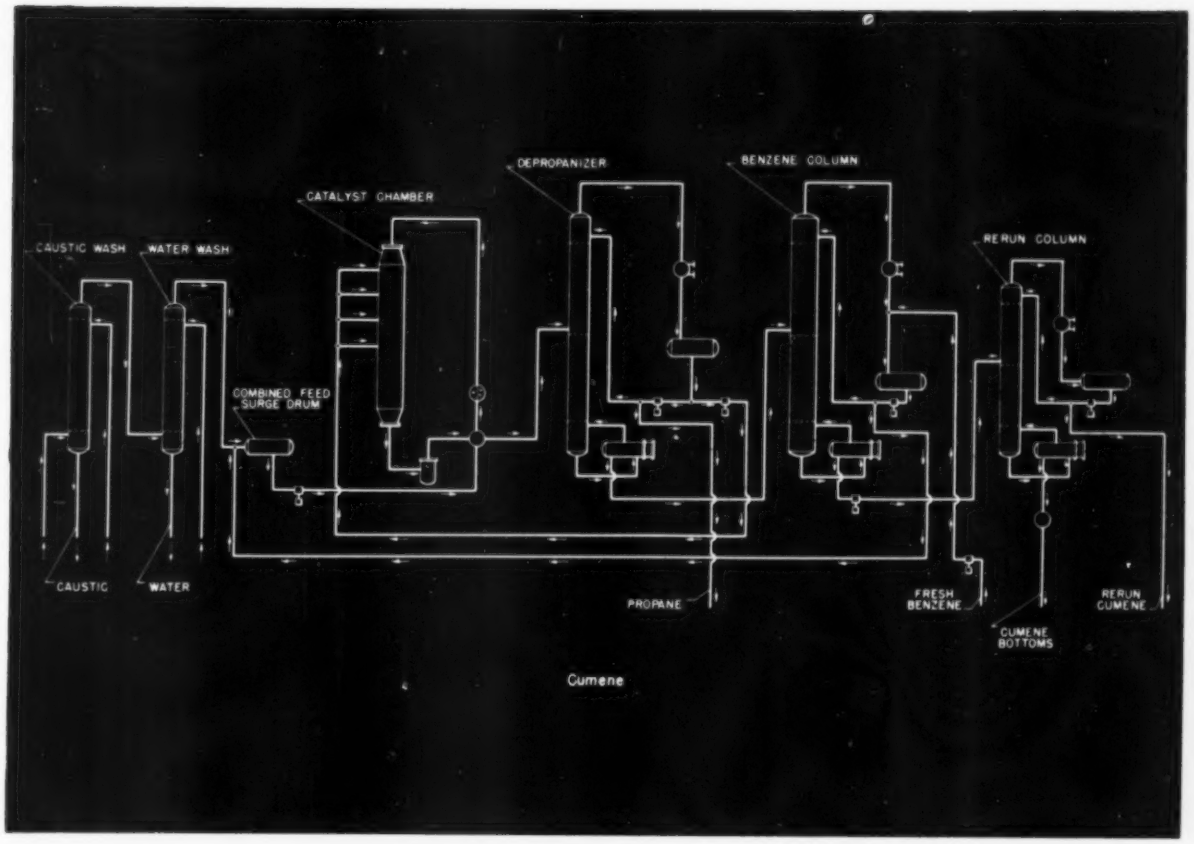
$$C_6H_6 + H_2SO_4 \rightarrow C_6H_5SO_3 + H_2O$$
$$2C_6H_5SO_3H + Na_2SO_3 \rightarrow 2C_6H_5SO_3Na + SO_2 + H_2O$$
$$C_6H_5SO_3Na + 2NaOH \rightarrow C_6H_5ONa + Na_2SO_3 + H_2O$$
$$2C_6H_5ONa + SO_2 + H_2O \rightarrow 2C_6H_5OH + Na_2SO_3$$

Benzene is sulfonated with oleum to give a mixture consisting predominently of benzenesulfonic acid and sulfuric acid. This mixture is neutralized in agitated vessels. Sodium sulfite originating in a later (fusion) operation in the process is utilized in the first step. A slurry of sodium sulfate in a sodium benzene sulfonate solution results and sulfur dioxide gas is released. In the second neutralization step, a continuous adjustment with caustic soda solution is made.

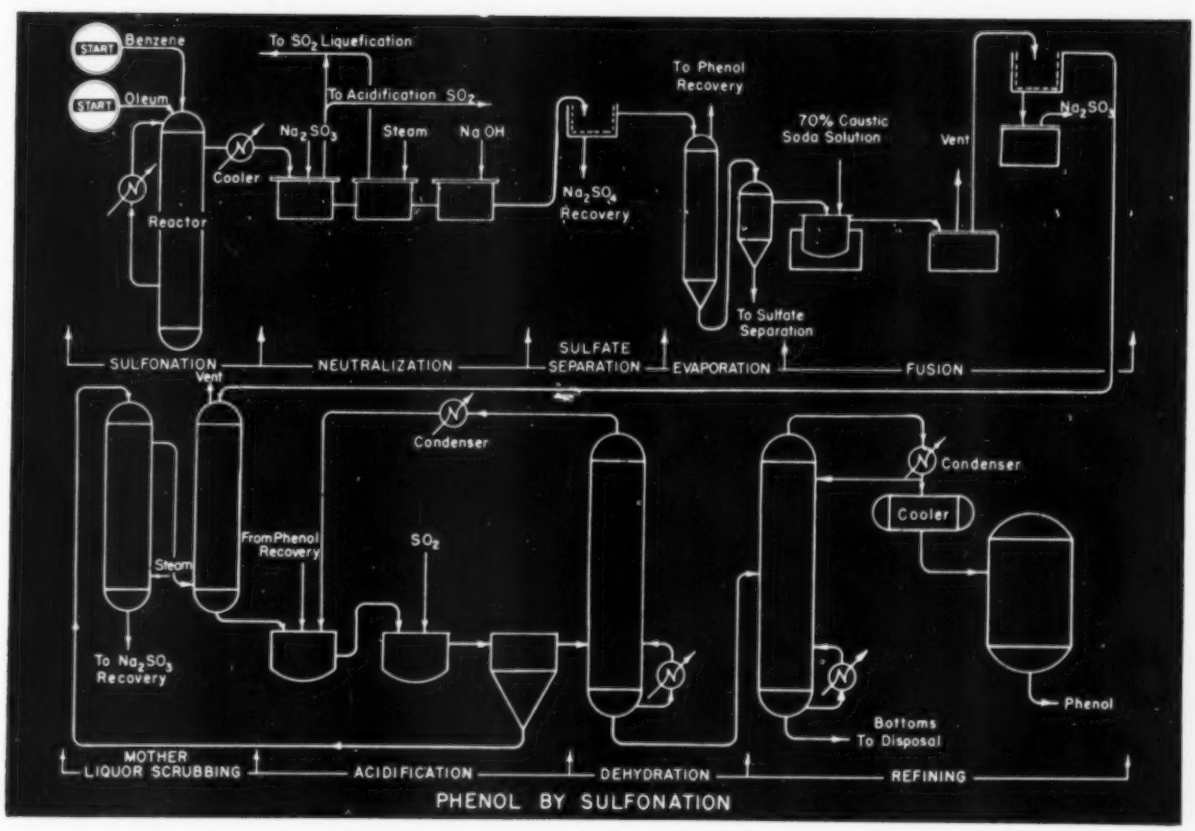
The sodium sulfate is removed in continuous centrifugals, and the resulting sodium benzene sulfonate solution is then concentrated in a continuous evaporator heated with steam. More sodium sulfate separates at this point and the vapors from the evaporator are scrubbed with caustic soda solution to recover phenol. The concentrated solution is fused with caustic soda supplied as a 70 percent solution. The fusion vessels are agitated cast iron pots set in furnaces fired with oil or gas.

The hot molten material at the end of the fusion is quenched in a vessel containing an appropriate quantity of water. Steam escapes through entrainment separators to the atmosphere. A solution of sodium phenate results in which is suspended sodium sulfite. The latter is removed in automatically cycled batch centrifugals, and after reslurrying with water, it is used in the neutralization step. The sodium phenate solution contains also some free sodium hydroxide and it is, therefore, used for absorbing phenol stripped from a mother liquor resulting from the following (acidification) step. Sodium phenate solution is acidified continuously, under controlled conditions, using sulfur dioxide gas from the neutralizers. The sodium sulfite formed is in aqueous solution and is decanted continuously in gravity separators from the second phase consisting of phenol and water. The sodium sulfite solution (mother liquor) contains some phenol. This is stripped from the solution with steam. The steam, in turn, is scrubbed with sodium phenate solution containing free sodium hydroxide, which combines with the phenol. Water is removed from the crude phenol by distillation, and the phenol is then distilled under reduced pressure to give the final product. A residue consisting of substituted phenols and tars remains behind. Sodium sulfate and sodium sulfite are recovered and sold as anhydrous salts. Excess sulfur dioxide is dried and liquefied for sale.

OPERATING CONDITIONS: Each step requires its own set of conditions. Temperatures, flow rates, pressures, pH, and specific gravities are process variables which are subject to control as the requirements of each step indicate.



Cumene



PHENOL BY SULFONATION

Amylphenols

SHARPLES CHEMICALS, INC.

APPLICATION: This process is applied to the manufacture of amylphenols.

CHARGE: The charge consists of phenol and pentenes.

PRODUCT: The products are tertiary and secondary amylphenols.

DESCRIPTION: The flow sheet shows the equipment and the process used in the production of both the tertiary and the secondary amylphenols. However, the conditions for their production differ.

Tertiary Amylphenols. The pentenes used in the manufacture of these amylphenols are obtained from the hydrolysis of amyl chloride which is covered in another section of this handbook. Two of them, 2-methyl-2-butene and 2-methyl-1-butene, are reacted with phenol to form the tertiary amylphenols. The reaction occurs in the presence of sulfuric acid. The alkylation autoclave is glass-lined to resist the action of the acid at the alkylation conditions. The reaction takes place at a temperature of about 120 F. Following inactivation of the sulfuric acid by the addition of water, the normal pentenes, which do not react under these conditions are vaporized and separated from the reaction mixture by means of distillation. The normal pentenes go overhead in this column, through a condenser and on to storage.

The alkylate and the aqueous layer in the reactor are separated, and the alkylate is pumped to the digester. In this equipment, the diamylene formed is removed from the product by taking the vapors out the top. These vapors are condensed, and then the diamylene is separated from the water.

The crude product is next neutralized by a dilute caustic solution. This crude is primarily p-tert-amylphenol. The separation of the crude into the isomeric monoamylphenols and the diamylphenol is accomplished in a batch vacuum still equipped with a steam ejector which provides a vacuum of 29 inches of mercury.

Secondary Amylphenols. These amylphenols are made by alkylating the unreacted pentenes from the tertiary amylphenol process with phenol under more rigorous conditions than in the process just described. The same type reactor is used, but the reaction temperature is 212 F. and the pressure over 150 psig.

The normal pentenes and the molten phenol are fed into the reactor along with a catalyst. The pressure in the alkylation autoclave determines the rate at which the pentenes can be fed to the reactor.

When the alkylation reaction has reached completion, the crude is neutralized with dilute caustic solution. After neutralization, the crude is pumped to storage before being fed to the batch vacuum still for fractionation. The vacuum on the still is maintained at 29 inches of mercury. This still is operated at a temperature in excess of 392 F. The fractionated products are the ortho-, para-, di- and poly-sec-amylphenols.

Amylnaphthalenes

SHARPLES CHEMICALS, INC.

APPLICATION: A process applied to the production of amylnaphthalenes.

CHARGE: The charge for this process is normal pentenes, amyl chloride and naphthalene.

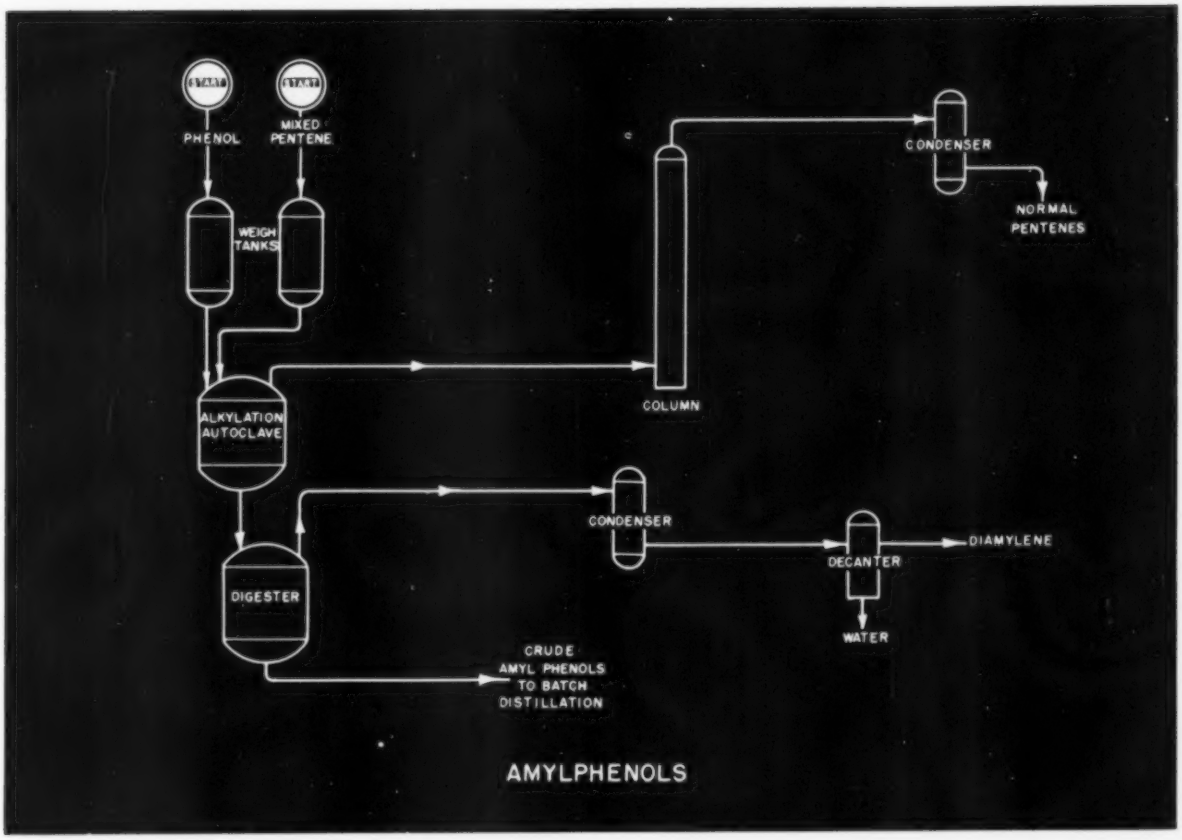
PRODUCT: A crude amylnaphthalene product from which can be separated the mono-, di-, and polyamylnaphthalenes.

DESCRIPTION: The amyl chloride and molten naphthalene enter the process system through weigh tanks so that the desired proportions are fed to the reactor. After these two chemicals are mixed in the reactor, the necessary dehydration of the mixture is accomplished by the azeotropic distillation of a portion of the amyl chloride. A Friedel-Crafts reaction using aluminum chloride is used to alkylate the naphthalene with normal pentene and amyl chloride. After the mixture of naphthalene and amyl chloride is dried in the reactor, aluminum chloride is added. With the addition of this material, the temperature in the reactor is increased. The hydrogen chloride formed is vented off through a scrubbing column, and then goes to a vent hydrogen chloride scrubber which, incidentally, is constructed of wood. When the greater part of the hydrogen chloride formed is vented from the system, an additional amount of aluminum chloride is added to the reactor. Normal pentenes are then pumped into the reactor at such a rate that the temperature in the reactor is maintained at a temperature of about 350 F. Vapors from the reactor are sent through the scrubbing column and then to a separator where the hydrocarbon is separated from the hydrogen chloride.

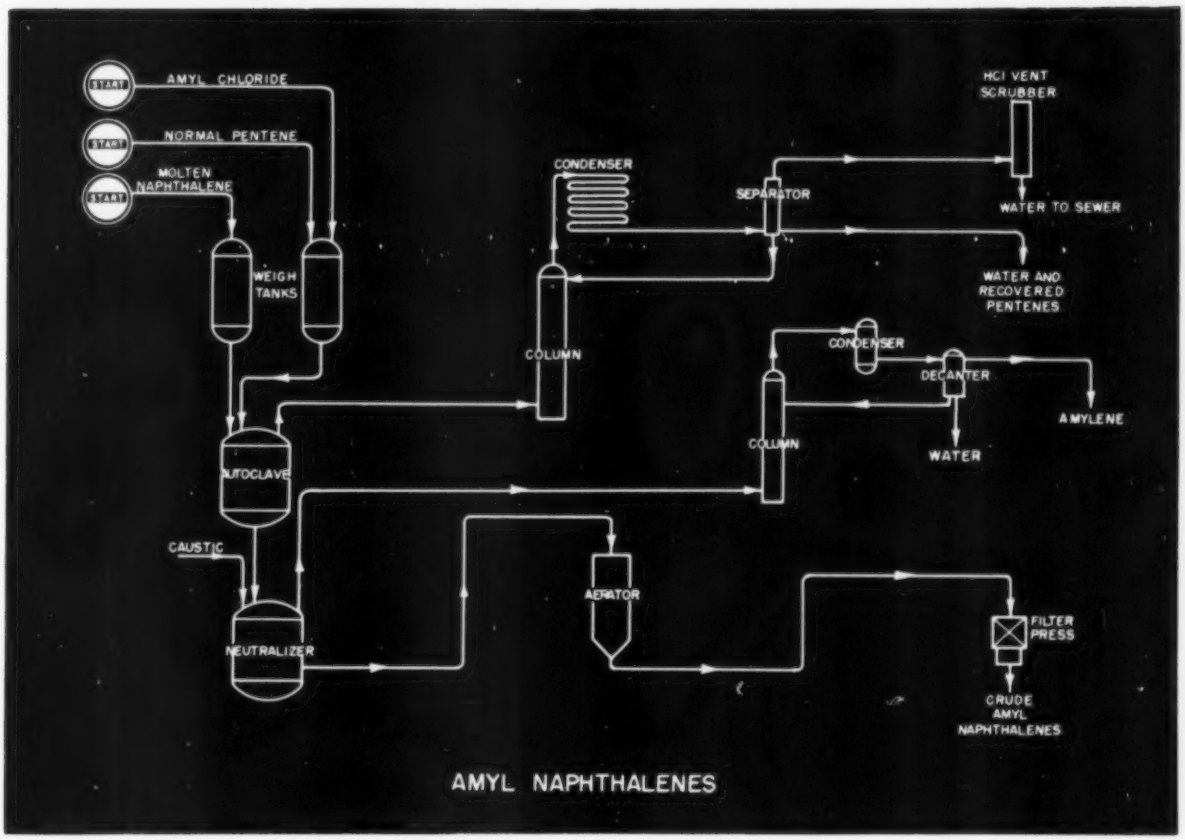
From the reactor the material is pumped to a neutralizer where the addition of a dilute caustic solution breaks down the aluminum chloride complex formed in the reactor. The unreacted amyl chloride and normal pentenes are distilled off this vessel to a recovery system where they are separated from the water brought into the system by the caustic solution. The crude amylnaphthalenes are separated from the aqueous layer in the neutralizer and are further dried in an aerator.

The crude product is then filtered. The dried and filtered crude is sent to a high-temperature vacuum still where the mono-, di- and poly-amylnaphthalenes are separated.

This process is integrated with the other processes in this group of amyl chemicals. The normal pentene used as charge stock is the unreacted pentene from the tert amylphenol reaction. The amyl chloride was produced in the process for making amyl alcohol.



AMYLPHENOLS



AMYL NAPHTHALENES

Ethylbenzene

APPLICATION: A process for manufacturing ethylbenzene.

CHARGE: Ethylene gas (90-95 mole-percent purity), benzene (styrene grade), anhydrous aluminum chloride, ethyl chloride.

PRODUCT: Ethylbenzene liquid (99.5+ percent purity), primarily for use in styrene manufacture.

DESCRIPTION: Benzene of about 99-percent purity is pumped from storage to the drying column where water is removed by azeotropic distillation. Dry benzene contains a maximum of 30 ppm water. This material is mixed with "catalyst complex" and makeup catalyst to form the alkylator charge. The hydrogen chloride, which serves as a promoter, is supplied indirectly from ethyl chloride which is mixed with the ethylene feed.

The "catalyst complex" consists of a mixture of heavy organics and the catalyst, solid anhydrous aluminum chloride of 97-98 percent purity. It is separated from the reaction products and recycled for its catalyst value. In the alkylator ethylene and benzene react to form ethylbenzene. Ethylene gas contacts the charge of benzene, catalyst, and complex in the alkylator at a temperature of 200 F. and a pressure slightly above atmospheric. Ethylene conversion is near-quantitative.

The alkylator is usually a conventional stirred reactor or a packed tower. The reaction is exothermic and means for heat removal must be provided. Conversion of benzene to ethylbenzene is 30-40 percent per pass.

The alkylator effluent is separated from the heavier catalyst complex. It is then washed with water and caustic in separate steps.

The crude alkylate contains 40-45 percent benzene, 15-20 percent higher-ethylbenzenes, a small amount of tar, and the remainder ethylbenzene. Separation is carried out in a train of conventional fractionating columns. The arrangement of towers described here is only one of several in commercial use. The first column, operating at atmospheric pressure, removes benzene overhead. The bottoms stream passes to the second column in which product ethylbenzene is removed as the overhead stream. This column is usually operated at atmospheric pressure. The third column operates at a head pressure of about 50 mm Hg absolute and removes an overhead product of higher-ethylbenzenes. This material is reprocessed in a dealkylation step.

Over-all process yields are maintained at a high level by the dealkylation step (not shown on the flow diagram) which is similar to the alkylation step, except that higher reaction temperatures and different catalyst ratios are used. The higher-ethylbenzenes are broken down to benzene, ethylbenzene, and diethylbenzene.

YIELDS: Typical over-all process yields are as follows:

Benzene to ethylbenzene	96 percent
Ethylene to ethylbenzene	97 percent

COMMERCIAL INSTALLATIONS: Ethylbenzene units using this process or a variation are found as parts of the several styrene monomer plants throughout the country. Koppers Company recently installed a separate ethylbenzene unit in Port Arthur, Texas.

Styrene

APPLICATION: This process is applied to the manufacture of styrene monomer by the catalytic dehydrogenation of ethylbenzene.

CHARGE: The charge is ethylbenzene.

PRODUCT: High purity styrene monomer is the product.

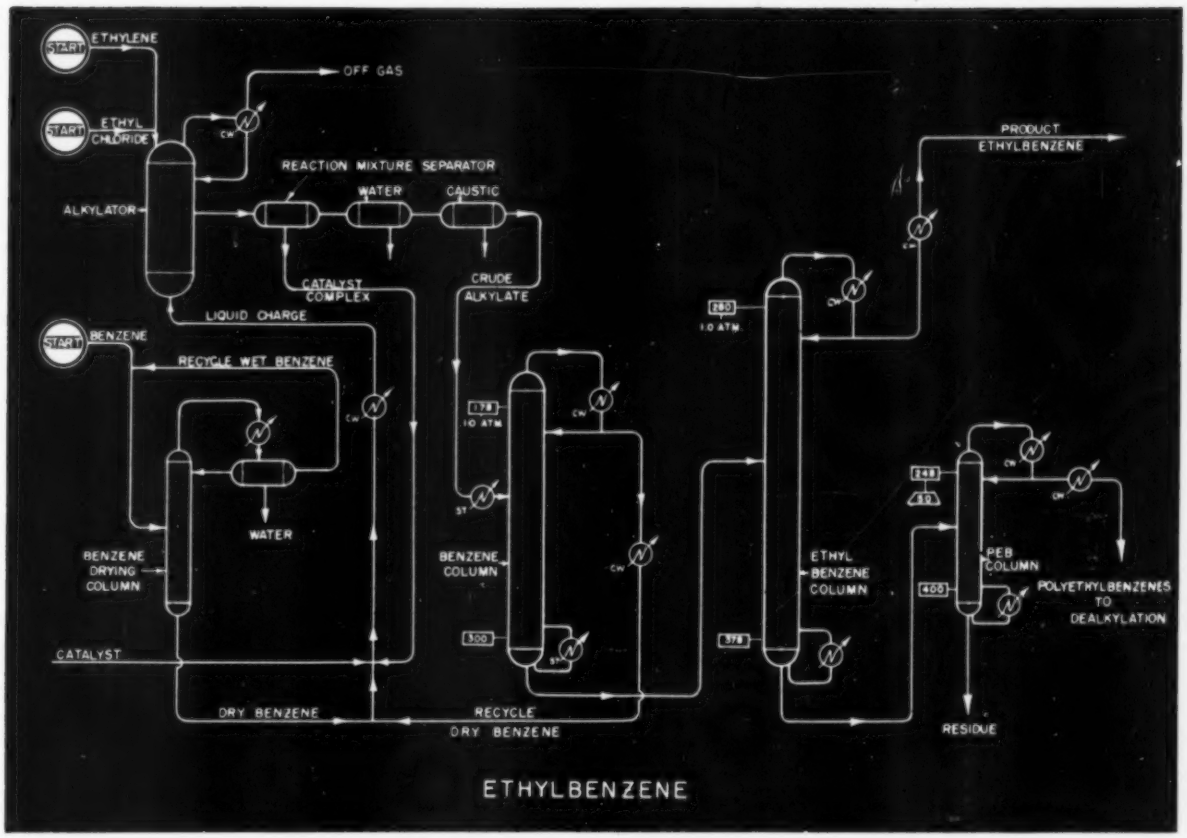
DESCRIPTION: Since reduced pressure favors the dehydrogenation reaction, steam is fed at a rate of 2.6 pounds per pound of ethylbenzene. About 90 percent of this steam is heated to about 725 F. before entering the superheating furnace which produces steam at 1310 F. The other 10 percent of the steam is mixed with ethylbenzene and passed through a vaporizer, being heated to 320 F. before heat exchange with hot reactor product. Ethylbenzene vapors at 970 F. are mixed with steam at 1310 F. in the reactor. The resulting temperature at the bottom of the catalyst bed is 1166 F. This temperature is the control point for the reaction system. Reactor product at 1049 F. is cooled by heat exchange, first with incoming ethylbenzene, and then with steam. From this point a spray-type desuperheater lowers the crude product temperature to 221 F. and condenses tars formed at high temperatures. Vapors then enter the final condenser, where steam, styrene, ethylbenzene, benzene, toluene, and small amounts of tar are liquefied. Vent gases containing hydrogen, carbon monoxide, carbon dioxide, methane, ethane, plus some of the aromatics pass overhead to a refrigerated recovery system.

The final step is the purification of the crude dehydrogenated material containing about 37 percent styrene. Styrene polymerization difficulties can be avoided by distilling inhibited styrene in a system which never allows the concentrated monomer to exceed 194 F. Crude styrene passes through a pot containing sulfur. Enough sulfur is dissolved to act as a polymerization inhibitor. After preheating, the feed enters the 30-plate benzene-toluene column where benzene and toluene pass overhead at 135 F. The top of this column operates at 175 mm Hg., and reflux ratio of 12 to 1 is employed. Since styrene is still diluted with ethylbenzene and tar, a temperature of 205 F. is allowable at the bottom. Sulfur passes down the column and effectively inhibits the stripping zone.

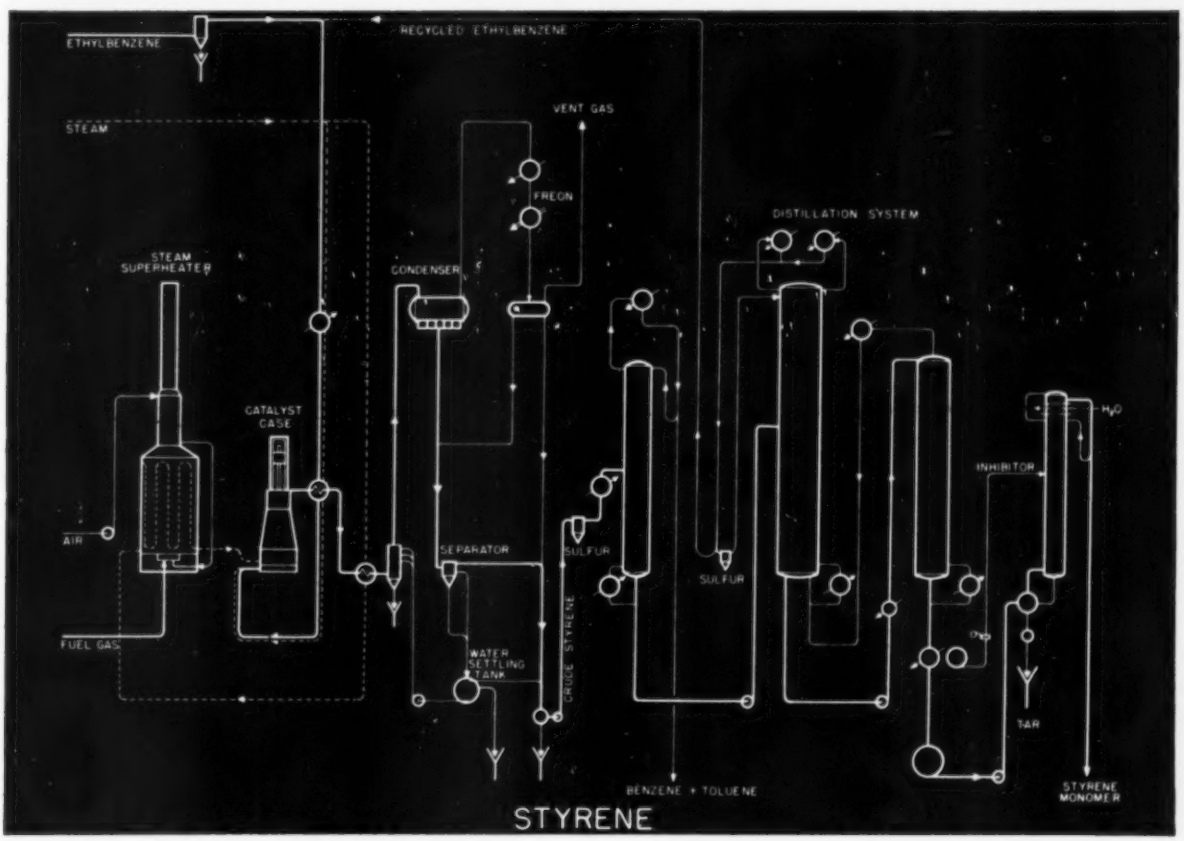
Ethylbenzene, styrene and tar are fed to the primary ethylbenzene column. To overcome the difficulties of excessively high temperature on the bottom and excessive pressure drop, the separation of ethylbenzene and styrene is effected in two steps. The primary ethylbenzene column acts as the top 38 plates and the secondary ethylbenzene column acts as the bottom 32 plates. Vacuum jets and cooling water keep the top of each at 35 mm Hg. so that bottom temperatures can be held at a safe level of 194 F.

The overhead of the primary column is ethylbenzene containing about 1 percent styrene which is recycled back to dehydrogenation feed. The bottom stream is fed to the secondary column where styrene and tar are taken out the bottom and fed to a packed batch styrene finishing still operating at 35 mm Hg. pressure. Tar and sulfur are removed in this still. An inhibitor, tertiary butyl catechol, is added to the styrene in the concentration of 10 ppm before shipment of the styrene product.

YIELDS: Conversion of ethylbenzene to styrene is about 37 percent per pass. Over-all yield amounts to about 90 percent.



ETHYLBENZENE



STYRENE

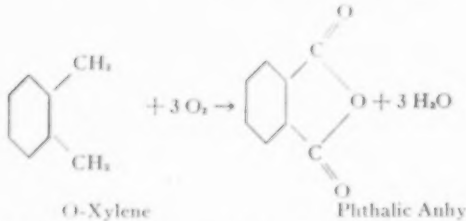
Phthalic Anhydride

APPLICATION: This process is applied to the manufacture of phthalic anhydride.

CHARGE: The charge is ortho-xylene.

PRODUCT: The product is solid phthalic anhydride.

DESCRIPTION: The liquid ortho-xylene feed is pumped at controlled rates into steam-heated vaporizers. The vaporized xylene is fed to a mixer where it is contacted with heated air. This mixture then goes to salt-cooled converter units where the following reaction occurs:



O-Xylene Phthalic Anhydride

This direct oxidation of the xylene to phthalic anhydride is promoted by the catalyst in the converter tubes which is based on vanadium pentoxide (V_2O_5). This catalyst must be carefully prepared for proper catalyst activity.

The reacted mass leaving the bottom of the converters passes through tubular heat exchangers where the gases are cooled before passing into condensers. The crude phthalic anhydride crystals deposited in the condenser units are withdrawn at regular intervals. The spent gases passing from the condensers go into furnaces fitted with gas burners so as to eliminate fume nuisance.

The crystals of crude phthalic anhydride removed from the condensers are melted in steam-heated melt tanks, the molten anhydride being distilled batchwise in two distillation stills in series. Free and combined water is taken off as the first cut from the primary still. The second cut, containing the phthalic anhydride and light boilers such as maleic anhydride, is taken off under vacuum and fed to the secondary still. Condensing phthalic anhydride must be held above its melting point to prevent operational difficulties due to solidification in tubes and transfer passages. The purified phthalic anhydride is removed as an overhead stream from the second distillation still which also operates under vacuum. The bottoms in the secondary still are returned to the primary still. The product goes from the secondary still to an aluminum storage tank. From this tank it is fed to a stainless-steel water-cooled surface for solidification. The final product in the form of chips is weighed and packed in paper bags.

OPERATING CONDITIONS: The most important operating conditions are the air/hydrocarbon ratio, the temperature in the converter and the contact time. Typical operating ranges for these variables are given below:

Air/Hydrocarbon Ratio	25-30
Temperature, F.	750-880
Contact Time, seconds	0.6

NOTE: It should be pointed out that about 10 percent of the total phthalic anhydride made in this country is made by the direct oxidation of o-xylene. The remainder is made by the direct oxidation of naphthalene.

Arosorb

SUN OIL COMPANY

APPLICATION: The process is primarily for the separation of aromatics from various refinery streams.

CHARGE: The Arosorb unit shown is for processing catalytic reformate, kerosine and catalytic gas oil.

PRODUCTS: These include high boiling aromatic solvents, saturated odorless spirits, and high cetane diesel fuel, all obtained directly. The process will also produce high purity benzene, toluene, and xylenes when used with fractional distillation.

DESCRIPTION: The stream quantities and the method of operation apply specifically to the processing of 4100 barrels per calendar day of kerosine. The viscosity of the kerosine charge is reduced by blending with a low-boiling saturate fraction. The desorbent consists of toluene diluted with about 35 percent of the low-boiling saturate fraction. The blended charge is pretreated by passing over activated alumina or other suitable material for the removal of water and other gel poisons. After pretreatment, the charge flows to one of three silica gel adsorption columns for 80 minutes. The charge then is diverted to another adsorption column and the first column is flushed with desorbent for 70 minutes, at the end of which time the gel is ready to receive charge again.

The charge aromatics are adsorbed by the silica gel bed, leaving the bulk of the charge saturates in the voids around the gel particles. The desorbent first pushes the charge saturates out of the silica gel bed, and then displaces the charge aromatics adsorbed on the gel to complete the cycle.

The effluent from each cycle is divided into two parts. The first portion containing the charge saturates, goes to the fractionation section, T-1, where the saturate product is removed as bottoms and the desorbent plus charge diluent is taken overhead and fed to T-3 for recovery. The second portion, containing the charge aromatics, flows to T-2 where the aromatic product is withdrawn as bottoms and the desorbent is distilled overhead and combined with the desorbent bottoms from T-3 for reuse.

In processing catalytic gas oil the Arosorb unit is operated in the same general manner as for kerosine. However, for the production of benzene and toulene, dilution of the charge is not necessary and a crude xylenes fraction is used as the desorbent. Pure aromatics are then obtained by fractional distillation.

OPERATING CONDITIONS: The adsorption columns are rated for 130 F. and 150 psi.

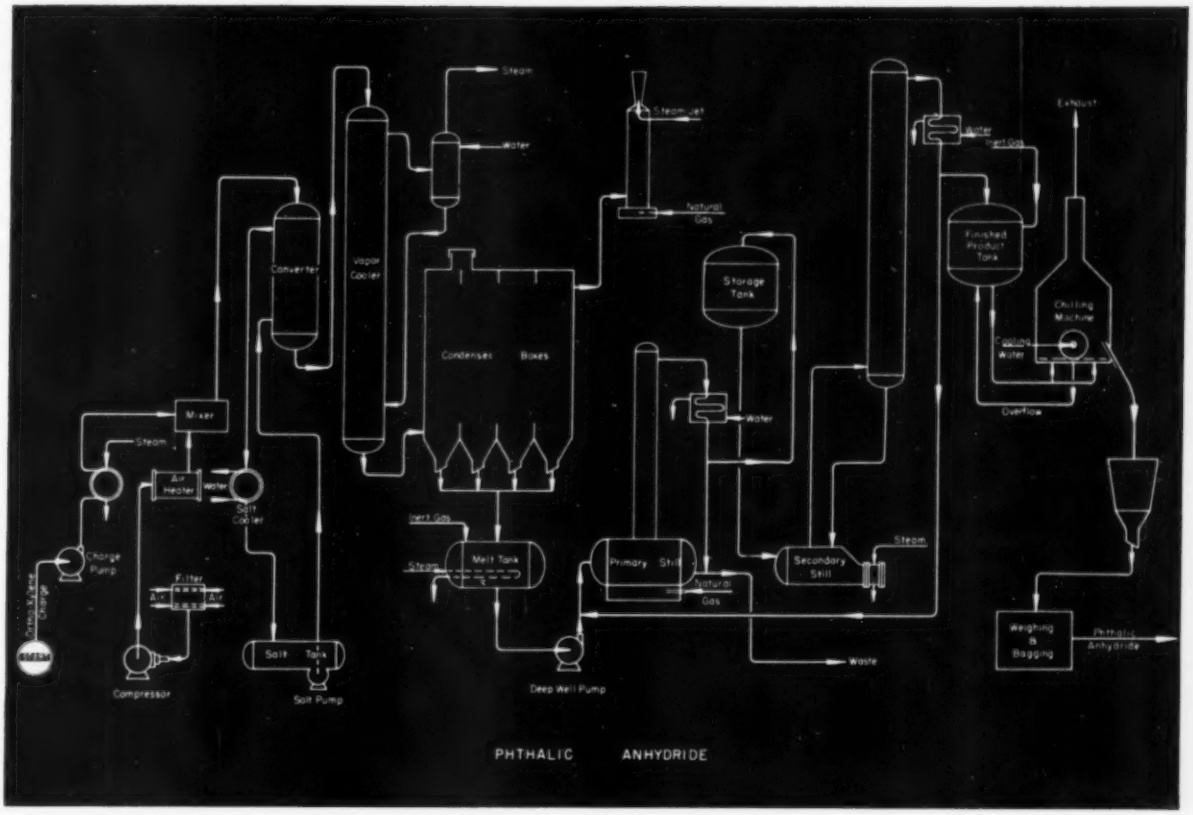
YIELDS: Typical operating data are given below. About 95 percent of the benzene and toluene in 2500 barrels per calendar day of catalytic reformate can be recovered.

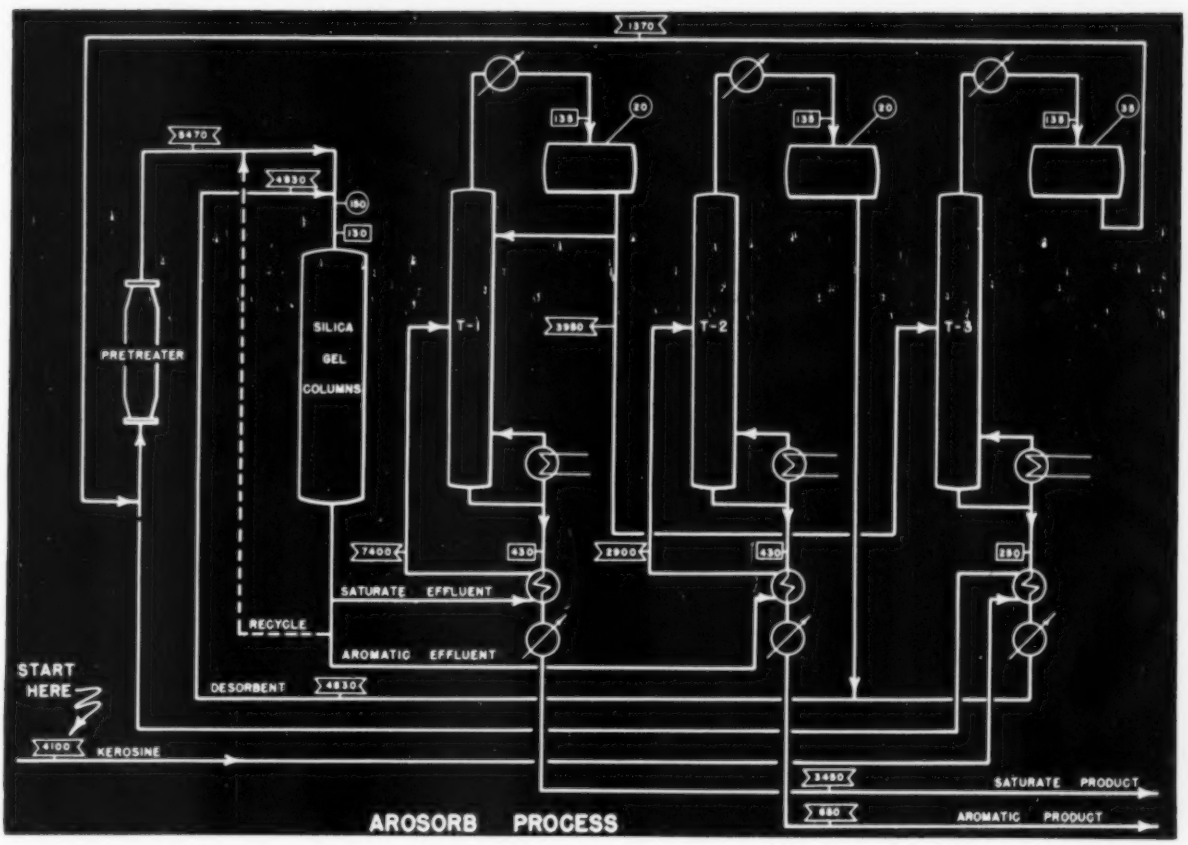
Processing 4100 Barrels For Calendar Day of Kerosine

Kerosine	Charge	Aromatic Product	Saturate Product
Yield, Volume Percent	100	16	84
Weight Percent Aromatics	16	91	1
Gravity, °API/60° F.	43.3	24	47.0
Aniline Point, °F.	143.4	75.2	164.7
Kauri Butanol Solvent	36.1	98.2	28.2

Processing 2425 Barrels Per Calendar Day of Catalytic Gas Oil

Catalytic Gas Oil	Charge	Aromatic Product	Saturate Product
Yield, Volume Percent	100	35	65
Weight Percent Aromatics & Olefins	39	92	5
Gravity, °API/60° F.	29.3	11.1	41.2
Aniline Point, °F	131.8	72.7	181.8
DDT Solvent, Weight Percent 77° F.		42	
Cetane No.	40		68


Steam
Water
Steam Jet
Natural Gas
Exhaust
Converter
Vapor Cooler
Condenser Boxes
Storage Tank
Finished Product Tank
Cooling Water
Overflow
Mixer
Steam
Air Heater
Water
Salt Cooler
Inert Gas
Steam
Melt Tank
Primary Still
Secondary Still
Natural Gas
Charge Pump
Filter
Air
Air
Compressor
Salt Tank
Salt Pump
Deep Well Pump
Waste
Weighing & Bagging
Phthalic Anhydride
PHTHALIC ANHYDRIDE


1370
8470
4830
180
130
PRETREATER
SILICA GEL COLUMNS
T-1
T-2
T-3
3980
7400
430
2900
430
290
SATURATE EFFLUENT
RECYCLE
AROMATIC EFFLUENT
START HERE
DESORBENT
4830
4100
KEROSINE
3480
SATURATE PRODUCT
880
AROMATIC PRODUCT
AROSORB PROCESS

Azeotropic Fractionation

THE UNION OIL COMPANY OF CALIFORNIA

APPLICATION: The process has been used successfully for the production of high purity toluene from catalytic reformates and virgin naphthas. This process also can be used for the production of high purity benzene and xylene from petroleum fractions.

CHARGE: The charge stock for this process is the appropriate boiling range distillate containing either benzene, toluene or xylene. It may be either a virgin or cracked naphtha or the product derived from a catalytic reforming operation.

PRODUCT: Nitration-grade benzene, nitration-grade toluene or 95 percent plus xylene fraction can be produced.

DESCRIPTION: Major production of nitration-grade toluene has been carried out using this process. A flow diagram illustrating this process is shown. A mixture of methyl ethyl ketone and water is used as the azeotrope former and is introduced to the azeotropic distillation column with the toluene-containing fraction. A constant-boiling mixure of non-aromatic hydrocarbons, water and methyl ethyl ketone passes overhead, giving a bottom product of substantially pure toluene. To meet the specifications for nitration-grade toluene, a slight acid treat is used. The toluene is then caustic neutralized and water washed before being rerun in a finishing column.

The overhead from the azeotropic column, containing the non-aromatics water and the methyl ethyl ketone, is fed to the extraction column. The non-aromatics are removed overhead while the methyl ethyl ketone is extracted with water and goes out the bottom of the column. This stream is then fed to the azeotrope recovery column where the methyl ethyl ketone-water mixture used as the azeotrope former is recovered and recycled to the azeotroping column. Water from the bottom of the recovery column is recycled directly to the extraction column.

OPERATING CONDITIONS: In the recovery of toluene by the Azeotropic Fractionation process, a 2.5 to 1.0 ratio of methyl ethyl ketone to non-aromatic fraction is charged to the azeotropic distillation column. Other major operating conditions are indicated on the flow sheet.

YIELDS: Commercial yields have shown an over-all recovery in the range of 95 to 98 percent.

COMMERCIAL INSTALLATIONS: One unit at the Oleum Refinery of the Union Oil Company operated successfully throughout the war period producing nitration-grade toluene.

Extractive Distillation

SHELL DEVELOPMENT COMPANY

APPLICATION: The process has been used successfully for recovering nitration grade benzene, toluene, or xylene from appropriate petroleum fractions.

PRODUCT: The product has a purity of 98 to 99 percent and is satisfactory for most uses; however, acid treating and redistillation may be necessary to meet nitration specifications.

DESCRIPTION: The separation of aromatics from non-aromatic is accomplished by distillation of the petroleum fraction in the presence of an extractive solvent which has selective solvency for the aromatic and thus reduces its volatility relative to the non-aromatic components. The solvent usually used in this process is phenol, but in special cases other solvents such as cresylic acids or sulfolanes may be preferable.

The flow diagram illustrates the application of the process to production of nitration grade benzene from a C_6 depentanized catalytic reformate. The original charging stock is first fractionated to prepare an aromatic concentrate. The top product of this column is the aromatic concentrate which is fed to the extractive distillation column.

The extractive distillation column consists of a knock-back section and an extraction section. The aromatic concentrate is charged at a point near the middle of the extraction section, and as in ordinary fractionation, vaporization heat is supplied in a reboiler, and the overhead vapors after condensation are partially returned as reflux to the column. The top product contains essentially all the non-aromatics including the olefins and diolefins and only a trace of solvent. The bottom product is a mixture of the aromatic and solvent. The constituents are separated in the solvent stripping column. The aromatic is distilled off as top product, and the solvent is recycled to the extractive distillation.

The loss of aromatic in the raffinate from the extractive distillation column is primarily a matter of control but need not exceed one percent of the raffinate stream. Loss of solvent is small; other than by mechanical leakage, solvent is lost through upset operation of the knock-back section in the extractive distillation column and of the stripping column.

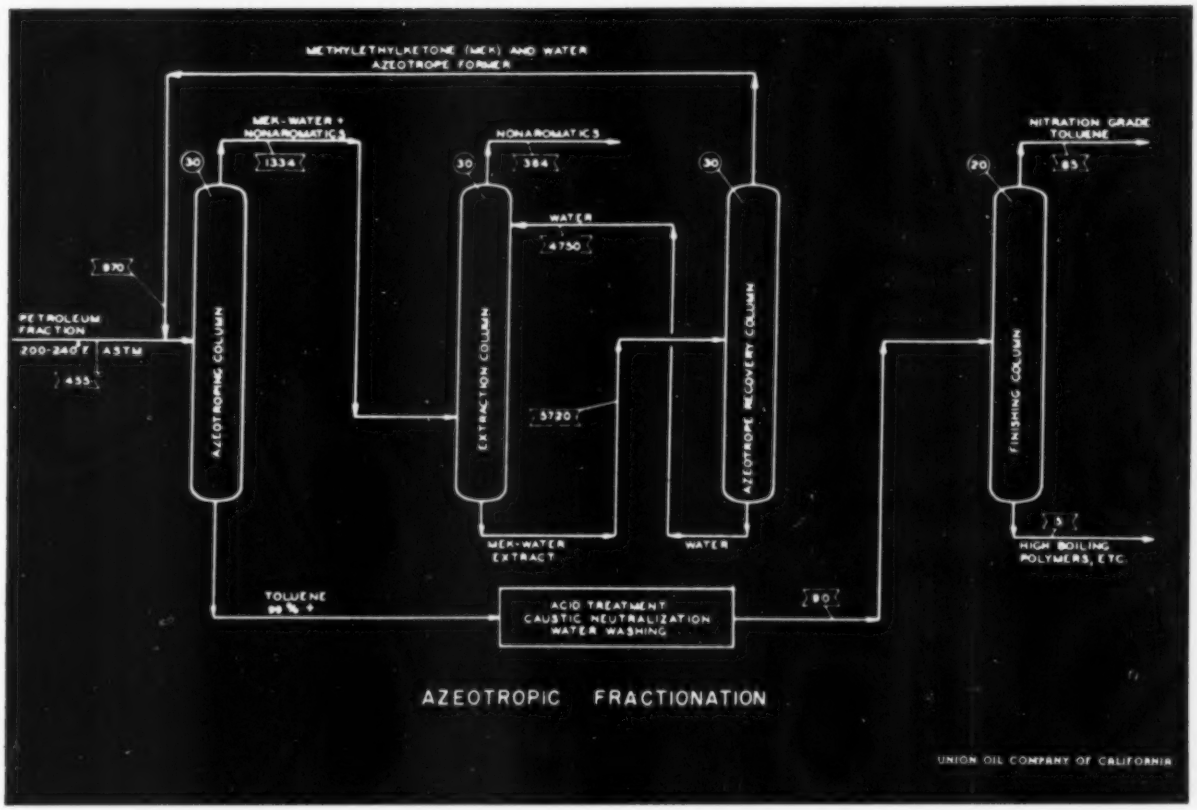
YIELDS: The table shows a material balance (solvent-free basis) for producing nitration grade benzene from depentanized catalytically reformed C_6 naphtha.

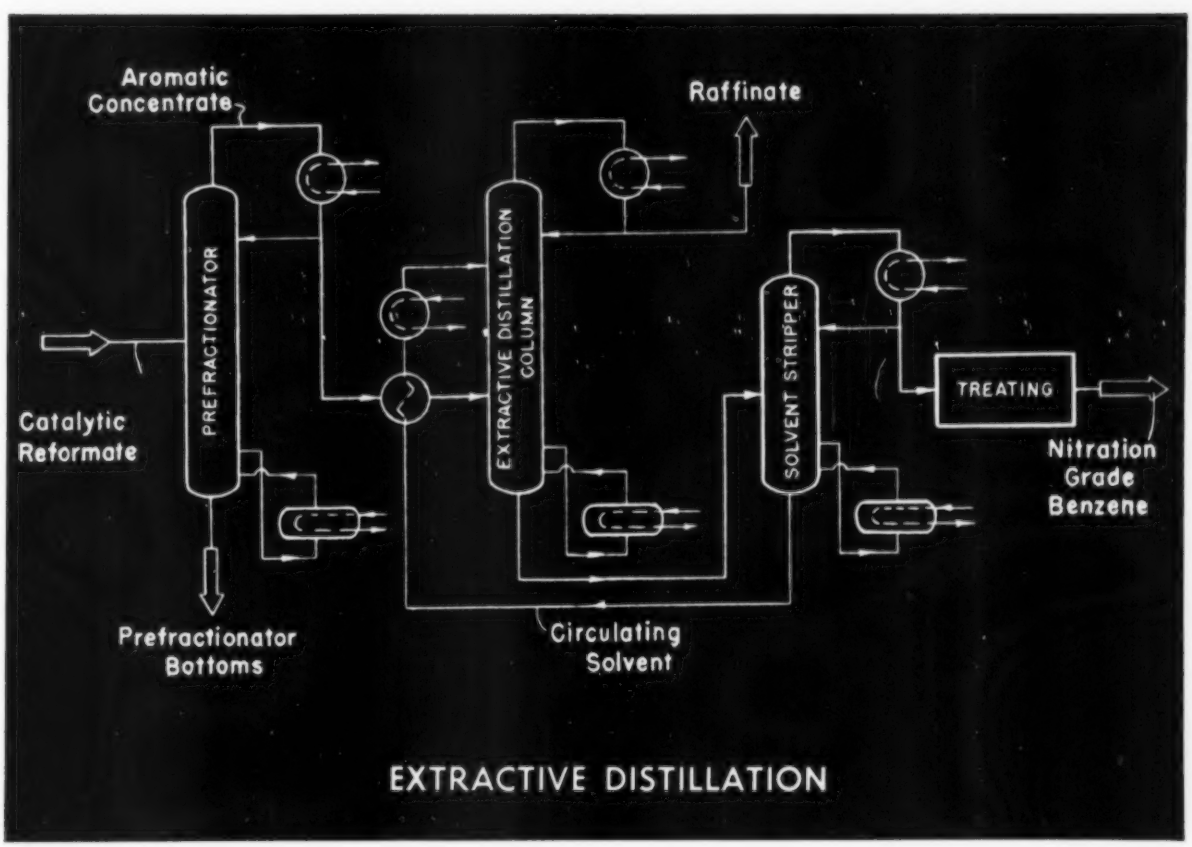
	Feed		Top Product		Bottom Product	
	Bbl./sd.	%v Benzene	Bbl./sd.	%v Benzene	Bbl./sd.	%v Benzene
Benzene Concentration	2214	45.9	2004	50.5	210	2.0
Extractive Distillation	2004	50.5	994	1.0	1010	99.2
Solvent Stripping	1010	99.2	1010	99.2	Solvent	
Redistillation*	1010	99.2	1000	99.5	10	

* After acid treatment and caustic wash.

COMMERCIAL INSTALLATIONS: The table below lists the units now operating and under construction.

COMPANY	LOCATION	AROMATIC
I. Now Operating:		
1. Continental Oil Company	Ponca City, Oklahoma	Benzene, toluene
2. Pan American Refining Corporation	Texas City, Texas	Benzene
3. The Pure Oil Company	Toledo, Ohio	Toluene
4. Shell Oil Company	Wilmington, Calif.	Benzene, toluene and xylenes
5. Shell Oil Company	Wood River, Illinois	Toluene, xylenes
6. Standard Oil Company (Indiana)	Whiting, Indiana	Benzene
II. Under Construction:		
1. Atlas Oil Processing Company	Shreveport, Louisiana	Benzene
2. Shell Oil Company	Houston, Texas	Benzene, toluene
3. Standard Oil Company of California	El Segundo, Calif.	Benzene


METHYLETHYLKETONE (MEK) AND WATER
AZEOTROPE FORMER
MEK-WATER + NONAROMATICS
1334
NONAROMATICS
384
WATER
4750
NITRATION GRADE TOLUENE
185
870
PETROLEUM FRACTION
200-240°F ASTM
435
AZEOTROPING COLUMN
EXTRACTION COLUMN
AZEOTROPE RECOVERY COLUMN
FINISHING COLUMN
5720
5
HIGH BOILING POLYMERS, ETC.
MEK-WATER EXTRACT
WATER
TOLUENE 99 % +
ACID TREATMENT
CAUSTIC NEUTRALIZATION
WATER WASHING
80
AZEOTROPIC FRACTIONATION
UNION OIL COMPANY OF CALIFORNIA


Aromatic Concentrate
Raffinate
PREFRACTIONATOR
EXTRACTIVE DISTILLATION COLUMN
SOLVENT STRIPPER
TREATING
Catalytic Reformate
Nitration Grade Benzene
Prefractionator Bottoms
Circulating Solvent
EXTRACTIVE DISTILLATION

Modified SO_2 Extraction

STONE & WEBSTER—BADGER

APPLICATION: This process is applicable to the recovery of pure or highly concentrated aromatics from selected virgin naphthas, catalytic reformates, and heavier petroleum distillates.

CHARGE: Charge stock for this process can be any selected virgin naphtha containing aromatics, a reformate stream from a catalytic reforming unit, or a gas oil stream containing aromatics.

PRODUCTS: In the processing of total reformates or of wide range virgin naphtha fractions, the process will simultaneously produce a highly concentrated benzene cut suitable for many industrial applications, nitration-grade toluene and a high-purity xylene and ethyl benzene fraction. If the benzene is to be nitration-grade, the process is supplemented by distillation facilities for final purification of this fraction. Typical purity and recovery of aromatics possible with such a plant are:

Aromatic	Purity	Recovery
Benzene	Nitration grade	90%
Toluene	Nitration grade	98%
C_8 Aromatics	90% plus	95-97%

DESCRIPTION: The schematic flow diagram illustrates a plant for the recovery of C_6 to C_8 aromatics from a catalytic reformate. In this plant both the primary extraction of aromatics and the extract stripping are carried out at a temperature of —20 F. The liquid sulfur dioxide used for the extraction serves also as a refrigerant. The primary extraction of aromatics takes place in the upper half of an extraction tower equipped with packing or suitable trays and the extract stripping step is carried out in the lower half of that tower. The stripping agent, herein called wash oil, is a kerosine.

The charge stock, if containing appreciable water, is passed through driers. The charge stock is then chilled by cold SO_2 in a reboiler-type chiller before it is introduced into the center of the extraction tower. Cold liquid SO_2 from the chillers is pumped into the upper section of the extraction tower, while chilled wash oil enters the tower near the base. The contact of the charge stock with SO_2 and the stripping of the extract solution produces a raffinate phase containing the nonaromatic hydrocarbons of the boiling range of the naphtha, the bulk of the wash oil and some SO_2. The extract phase consists largely of aromatics and SO_2 and contains the remainder of the wash oil. The extractor operates under sufficient liquid pressure so that the two phases move to their respective recovery systems without intermediate pumping.

OPERATING CONDITIONS: For the recovery of C_6 to C_8 aromatics from a reformate, an SO_2 rate of about 170 volume percent based on reformate charge is required. The wash oil rate will be 50 to 75 volume percent.

COMMERCIAL INSTALLATIONS: Two installed and one under construction.

Udex Extraction

UNIVERSAL OIL PRODUCTS COMPANY

APPLICATION: The process employs a mixture of glycol and water as a solvent for the separation of high purity aromatics from mixtures with other hydrocarbons.

CHARGE: The outstanding feature of the process is its ability to handle wide boiling range stocks. The fraction fed to the unit can be as widely boiling as necessary so as to assure inclusion of all of the potential aromatics without interference with the purity of the product, and the difficulties in fractionation which result from nonideality of mixtures of hydrocarbon types are avoided.

PRODUCT: Nitration-grade benzene, nitration-grade toluene, and a xylene-ethylbenzene concentrate of high purity can be obtained as products. Bottoms from the xylene fractionator represent a concentrate of C_{9+}, C_{10+} and C_{11} aromatics.

DESCRIPTION: The process uses an efficient multistage countercurrent extraction column of a novel design developed especially for this purpose. Solvent is fed at the top of the column; hydrocarbon feed, at an intermediate point; and hydrocarbon reflux, at the bottom. The rich solvent is taken to a stripper, wherein the dissolved aromatics are separated from the solvent, the latter being recirculated to the extraction column. Vapors from the stripper are condensed and separated into two phases. The water phase is used in part to wash traces of dissolved glycols from the raffinate; the remainder is returned to the stripper. The hydrocarbon phase from the stripper receiver is a mixture of aromatics from which the benzene, toluene, and a mixed ethylbenzene-xylene fraction—all of high purity—are separated by distillation.

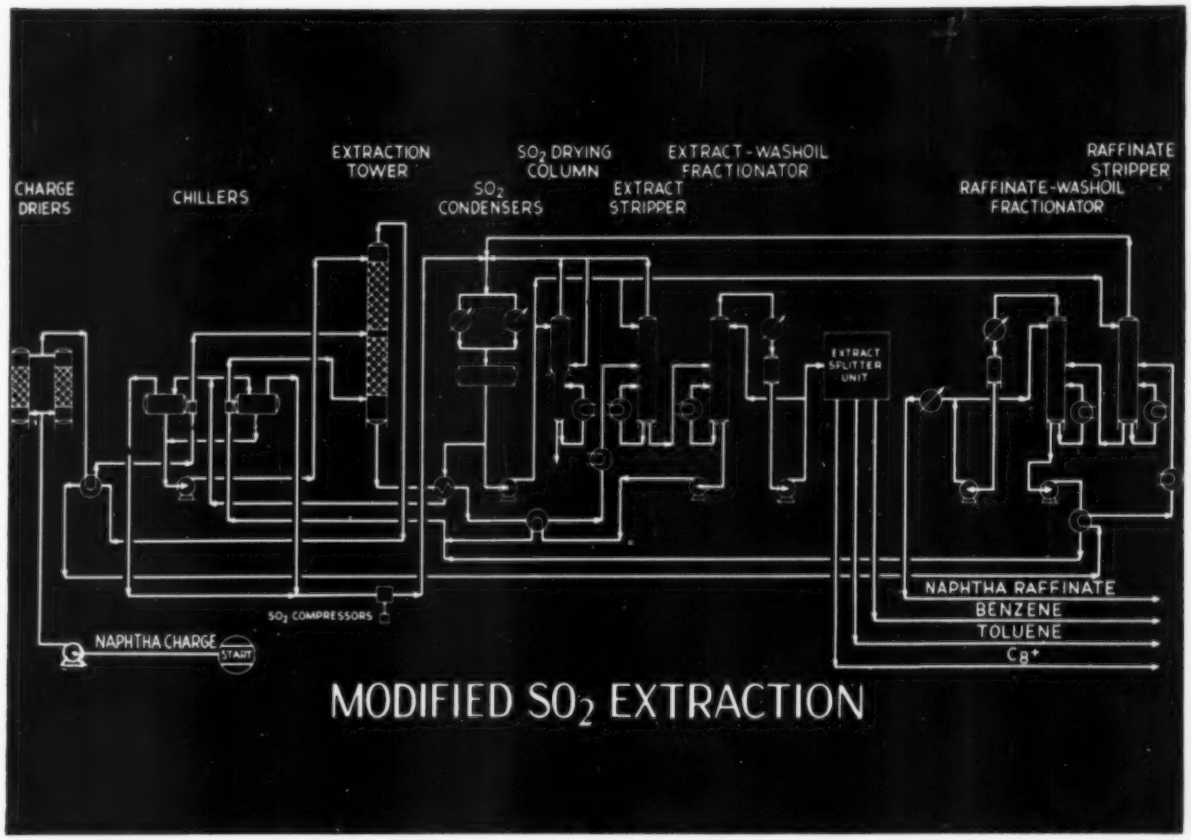
YIELDS: Yields on UDEX extraction and distillation of typical Platformate are shown in the tables.

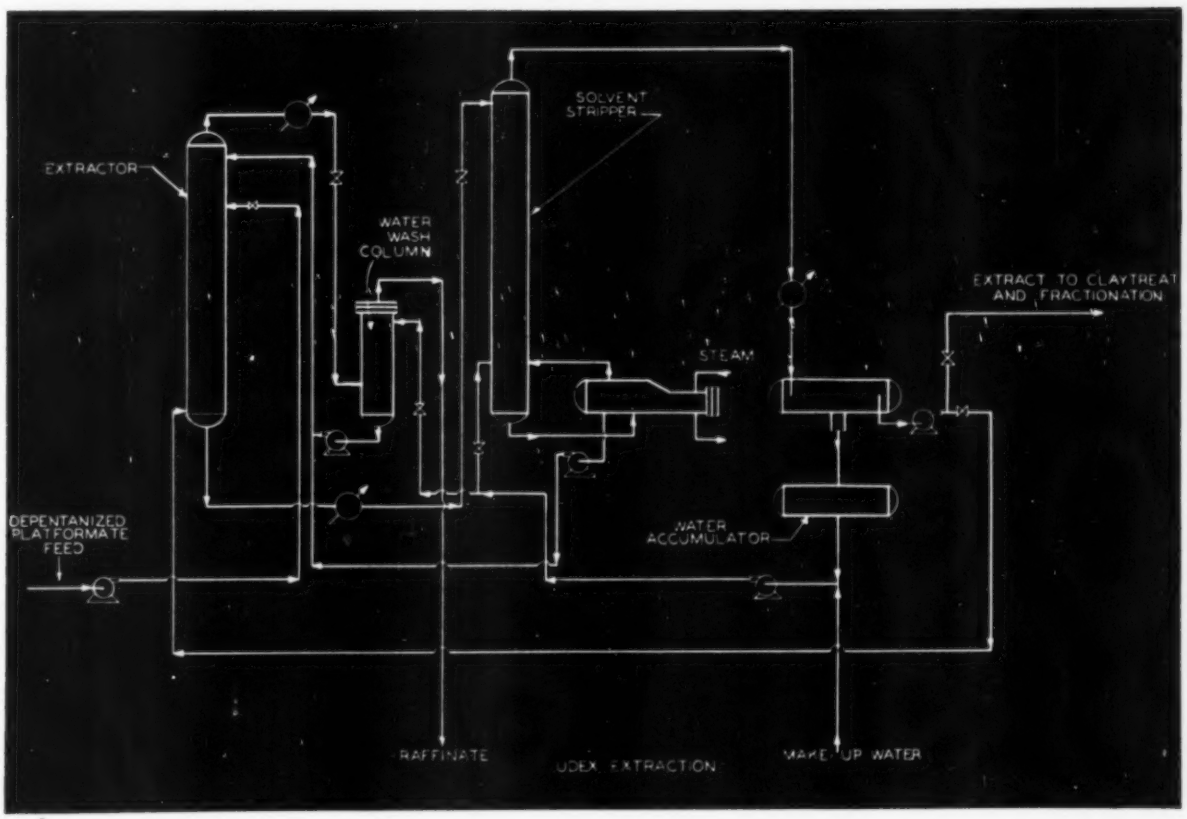
COMMERCIAL INSTALLATIONS: At the present time, there are three Udex units ranging from 950 to 1635 barrels of charge per day in commercial operation. Three others are in various stages of construction.

Product Properties	Udex Charge	Raffinate	Benzene	Toluene	Mixed Xylenes
Gravity, °API	51.9	76.4			
Specific Gravity, d 20/4	.7715	.6806	.885	.873	.873
Percent Aromatics	51.3	3.5	99.9	99.8	99+
Solidifying Point °C			5.49		
Distillation	**F.**	**F.**	**C.**	**C.**	**C.**
IBP	150	145	79.7	110.2	*
50 Percent	210	170	80.1	110.8	
Dry Point	302	295	80.3	111.0	
Acid Wash Color					
Color of Acid Phase			0	0+	0+
Color of Hydrocarbon Phase			0	0	0+
Acidity, Mgs. NaOH/100 ml. Sample			No Free Acid		
Copper Strip Corrosion			Passed		

* Ethyl benzene, 14.5 weight percent; p-xylene, 19.0 weight percent; m-xylene, 42.0 weight percent; o-xylene, 24.5 weight percent.

YIELDS	Percent by Volume of Extract	Percent by Volume of Udex Charge	Percent Recovery in Extract
Benzene	15.3	7.6	99+
Toluene	42.5	21.2	98
Xylenes and Ethyl Benzene	40.4	20.0	94
C_9 Plus Aromatics	1.8	0.9	75
Total Extract	100.0	49.7	
Raffinate		50.3	
UDEX Charge		100.0	


CHARGE DRIERS
CHILLERS
EXTRACTION TOWER
SO2 CONDENSERS
SO2 DRYING COLUMN
EXTRACT STRIPPER
EXTRACT - WASHOIL FRACTIONATOR
RAFFINATE-WASHOIL FRACTIONATOR
RAFFINATE STRIPPER
EXTRACT SPLITTER UNIT
SO2 COMPRESSORS
NAPHTHA CHARGE
START
NAPHTHA RAFFINATE
BENZENE
TOLUENE
C8+
MODIFIED SO2 EXTRACTION


EXTRACTOR
SOLVENT STRIPPER
WATER WASH COLUMN
EXTRACT TO CLAYTREAT AND FRACTIONATION
STEAM
WATER ACCUMULATOR
DEPENTANIZED PLATFORMATE FEED
RAFFINATE
UDEX EXTRACTION
MAKE UP WATER

Ammonia and Methanol

CHEMICAL CONSTRUCTION CORPORATION

APPLICATION: This is the Nitrogen Engineering Corporation process for the manufacture of ammonia and methanol.

CHARGE: The charge can be hydrocarbon gases such as coke oven gas, natural gas and certain petroleum refinery gases.

PRODUCT: The product can be either liquid anhydrous ammonia or high purity methanol.

DESCRIPTION:

Ammonia: The gas, assumed to be clean and low in sulfur content, enters the system at about 30 psig. Part of the gas is burned under the primary reformer (6) to provide heat required to reform the hydrocarbons in the gas. Waste heat from this operation is converted to process steam in boiler (5). The balance of the natural gas is passed through absorbent in the sulfur removal vessel (13). Steam is then combined with the gas and the mixture passed through preheater (12) and sent to the reaction tubes of the primary reformer (6). The catalyst in the tubes promotes the reaction between the hydrocarbons in the gas and the steam to form a gas mixture of hydrogen, carbon monoxide, carbon dioxide and small quantities of methane.

The gas mixture leaving the reaction tubes passes into a secondary reformer (8). This unit is provided with a burner at its inlet where air is supplied in sufficient quantity to provide the nitrogen required in the final mixture. The combustion of the gas with the oxygen in the air raises the temperature of the gas mixture before its passage through secondary reformer catalyst, thereby promoting the conversion of the residual methane. The gas mixture leaving the secondary reformer is cooled in a waste heat boiler (10) to reduce its temperature to the level required for the oxidation of carbon monoxide to carbon dioxide and hydrogen. This reaction is accomplished by adding steam to the reformed gas and passing the mixture over the catalyst in the CO converter (11) where the following reaction takes place:

$$CO + H_2O = CO_2 + H_2$$

The converted gas, containing approximately three percent CO_2 is now split between the heat exchangers; one (12) to preheat the steam-gas mixture to the primary reformer, and the other (15) to preheat the steam to be added to the gas for CO oxidation. After this heat exchange the gas is cooled in a gas cooler (16) which condenses the excess steam in the gas. The gas leaves the reform section at about 20 psig.

The converted gas is then sent through purification and compression (19) to synthesis. The carbon dioxide is removed just prior to compression, and residual carbon monoxide is removed between the last two stages of compression. This results in a purified gas having the correct proportions of hydrogen and nitrogen for the synthesis of ammonia.

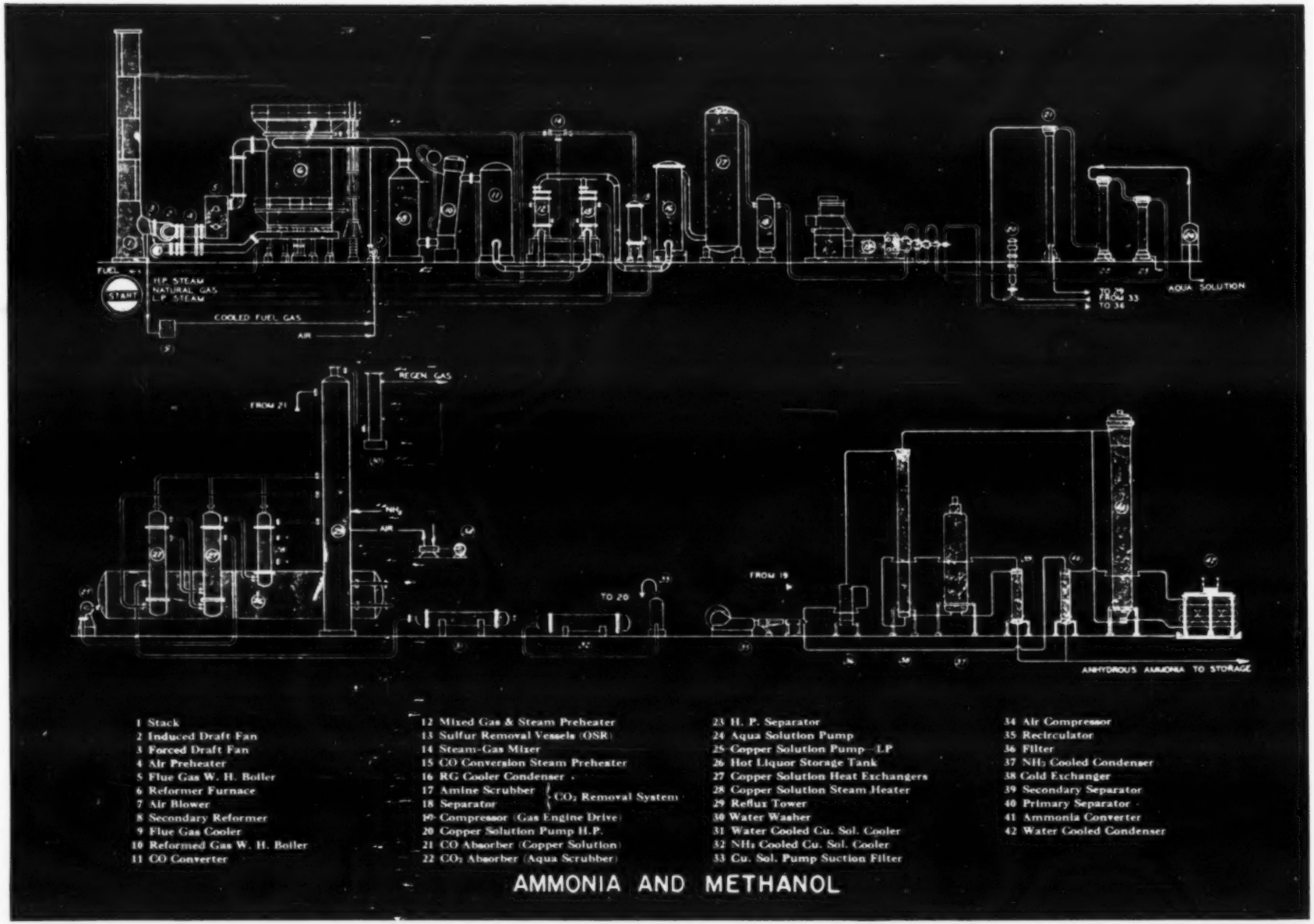
The carbon dioxide is absorbed in an aqueous solution of monoethanolamine. The spent amine from the scrubber (17) is sent to the regenerator where the dissolved gases are driven off at atmospheric pressure by heat, leaving the solution ready for recycling. At an interstage pressure of approximately 125 atmospheres the gases are scrubbed with an ammoniacal cuprous solution to remove impurities such as carbon monoxide, carbon dioxide and oxygen. The cuprous solution is circulated through the scrubbing tower (21) where it absorbs these impurities. The rich solution is then regenerated at atmospheric pressure by the heating of the solution in two heat exchangers (27) and a steam heater (28). The evolved gases are scrubbed with incoming spent solution in the reflux tower (29) for the recovery of ammonia. The final regeneration takes place in a hot liquor storage tank (26). The lean solution is cooled by water in (31) and evaporating ammonia in (32) before being returned to the scrubber by the high-pressure centrifugal pump (20). Washing the synthesis gas in the aqua ammonia tower (22) reduces the carbon dioxide to trace amounts. The gas leaving the aqua ammonia tower passes through separator (23) to the last stage of the compressor (19) where it is compressed to about 350 atmospheres and fed to the synthesis system.

The compressed hydrogen-nitrogen mixture is delivered to the synthesis system and mixed with the circulating gases in the oil filter (36). The gas circulated by compressor (35) contains some uncondensed ammonia and unconverted nitrogen and hydrogen. The mixture from the oil filter is sent to the cold exchanger (38) for precooling before entering the ammonia cooled condenser (37) where final condensation of ammonia from the gas takes place. This secondary condensation removes final traces of carbon dioxide and water vapor and is one of the patented features of the NEC process. It explains to a considerable degree the long life and high efficiency of the catalyst. Leaving the ammonia cooler the condensed ammonia is separated in (39) and drawn off into the ammonia storage tanks.

After removal of the condensed ammonia, the gas passes through the cold exchanger and enters the ammonia converter (41). There are two inlets to the ammonia converter; the main inlet near the top and a cold gas by-pass at the bottom. The by-pass inlet permits excellent control of the catalyst temperature. The converter is of patented design with a built-in heat exchanger and is charged with a high grade catalyst that actively promotes the conversion of nitrogen and hydrogen to ammonia. Leaving the converter the gases are cooled in the water-cooled primary condenser (42) where the greater part of the liquid ammonia is condensed and removed from separator (40) as liquid anhydrous ammonia. The uncondensed gases pass to the circulating compressor (35) and are recirculated through the system.

Methanol: Methanol can be made from the same raw materials as ammonia and in a plant of much the same type.

The gas reform section is operated under conditions slightly different from those for the production of ammonia synthesis gas. Reforming for methanol yields a gas rich in carbon monoxide and hydrogen. The major differences between reforming for ammonia and for methanol are, in the case of the methanol, a somewhat lower pressure level in the reformer, addition of carbon dioxide, and the absence of secondary reforming and CO-oxidation. The reformer section effluent gas is then compressed in (14) and CO_2 is removed. After final compression to synthesis it is passed over active charcoal and delivered to the synthesis section. After combination with the circulating gas in the oil filter (19) the mixture enters the converter. The product methanol is condensed almost in its entirety in the water cooler (22) and removed from the gas stream in separator (20). The gas is then returned to recirculator (18).



1 Stack
2 Induced Draft Fan
3 Forced Draft Fan
4 Air Preheater
5 Flue Gas W. H. Boiler
6 Reformer Furnace
7 Air Blower
8 Secondary Reformer
9 Flue Gas Cooler
10 Reformed Gas W. H. Boiler
11 CO Converter
12 Mixed Gas & Steam Preheater
13 Sulfur Removal Vessels (OSR)
14 Steam-Gas Mixer
15 CO Conversion Steam Preheater
16 RG Cooler Condenser
17 Amine Scrubber } CO_2 Removal System
18 Separator }
19 Compressor (Gas Engine Drive)
20 Copper Solution Pump H.P.
21 CO Absorber (Copper Solution)
22 CO_2 Absorber (Aqua Scrubber)
23 H. P. Separator
24 Aqua Solution Pump
25 Copper Solution Pump—LP
26 Hot Liquor Storage Tank
27 Copper Solution Heat Exchangers
28 Copper Solution Steam Heater
29 Reflux Tower
30 Water Washer
31 Water Cooled Cu. Sol. Cooler
32 NH_3 Cooled Cu. Sol. Cooler
33 Cu. Sol. Pump Suction Filter
34 Air Compressor
35 Recirculator
36 Filter
37 NH_3 Cooled Condenser
38 Cold Exchanger
39 Secondary Separator
40 Primary Separator
41 Ammonia Converter
42 Water Cooled Condenser

AMMONIA AND METHANOL

Ammonia and Urea

FOSTER WHEELER CORPORATION

APPLICATION: This is the Casale process for the manufacture of ammonia and the Pechiney urea process.

CHARGE: The charge is natural gas and air.

PRODUCTS: High purity ammonia and urea.

DESCRIPTION: The process consists of these stages: (1) air fractionation, (2) synthesis gas generation, (3) shift conversion, (4) carbon dioxide removal, (5) liquid nitrogen wash, (6) ammonia synthesis and (7) urea manufacture.

Air, after passing through filters and a caustic scrubber, is compressed to about 600 spig. Here, by means of heat exchange with effluent gases and a heat-removal expansion system, it is condensed to a liquid and then fractionated to liquid oxygen and nitrogen. The liquid oxygen is then heated and pumped at 400 psig pressure to the synthesis gas generator which was developed by The Texas Company and The Texaco Development Corporation. The liquid nitrogen is used in the nitrogen wash step and in the ammonia synthesis step.

The natural gas enters the generator where it mixes with oxygen. The products, mainly carbon dioxide and hydrogen, are cooled after the generation stage and then reheated to predetermined temperatures before going to the shift converter. Steam is added at the shift converter, and the conversion of carbon monoxide to carbon dioxide is completed over a catalyst. Additional hydrogen is freed from the dissociation of the water molecule, and the synthesis gas is then cooled before carbon dioxide removal. The synthesis gas generator requires no catalyst.

Carbon dioxide is removed by absorption from the gas stream with MEA (mono-ethanol-amine). The carbon dioxide is then stripped from the solvent.

The synthesis gas is then caustic washed and dried before entering the liquid nitrogen wash system. Here, essentially all gases except hydrogen are condensed out of the stream.

The gas stream then is mixed with enough nitrogen to establish molecular proportions and is fed to the Casale ammonia synthesis step. This gaseous mixture of hydrogen and nitrogen is compressed to approximately 12,000 psig, is cooled to about 100 F., and enters the reactor via the jet ejector system where ammonia is formed over a catalyst. The effluent gases are cooled, and then liquid is separated from gases. The unconverted gases are recirculated, and liquid anhydrous ammonia moves to storage or to the Pechiney urea production plant.

In the Pechiney process, the liquid anhydrous ammonia is pumped up to the pressure of the reaction system, 2900 psig, is heated to approximately 300 F., and joins the carbon dioxide entering the Pechiney reactor. The carbon dioxide has also been compressed to 2900 psig and preheated to about 500 F. In the reactor there is also present a circulating neutral oil containing recycle ammonium carbamate in the form of a finely dispersed solid or slurry. The urea-carbamate-oil mixture leaves the reactor and its pressure is reduced to 60 psig. In a liquid-vapor separating vessel the oil in slurry form is mixed with an aqueous solution of urea (the water is a product of the reaction) and is pumped from the bottom for liquid-liquid separation of the oil and the urea solution. The urea solution is concentrated and finished for the production of urea in solid form. The unconverted carbamate is recycled to the reactor as oil-carbamate slurry.

Urea

CHEMICAL CONSTRUCTION COMPANY

APPLICATION: This process is applied to the manufacture of synthetic urea.

CHARGE: Carbon dioxide and liquid ammonia are the charge.

PRODUCT: The product is urea in the form of spherical granules.

DESCRIPTION: The urea synthesis plant shown in the flow diagram is designed to produce granulated urea from liquid ammonia and gaseous carbon dioxide.

The gaseous carbon dioxide enters the process system where it is first compressed and then freed of sulfur, oxygen and inert gases. The purified carbon dioxide is liquefied and pumped to a surge tank.

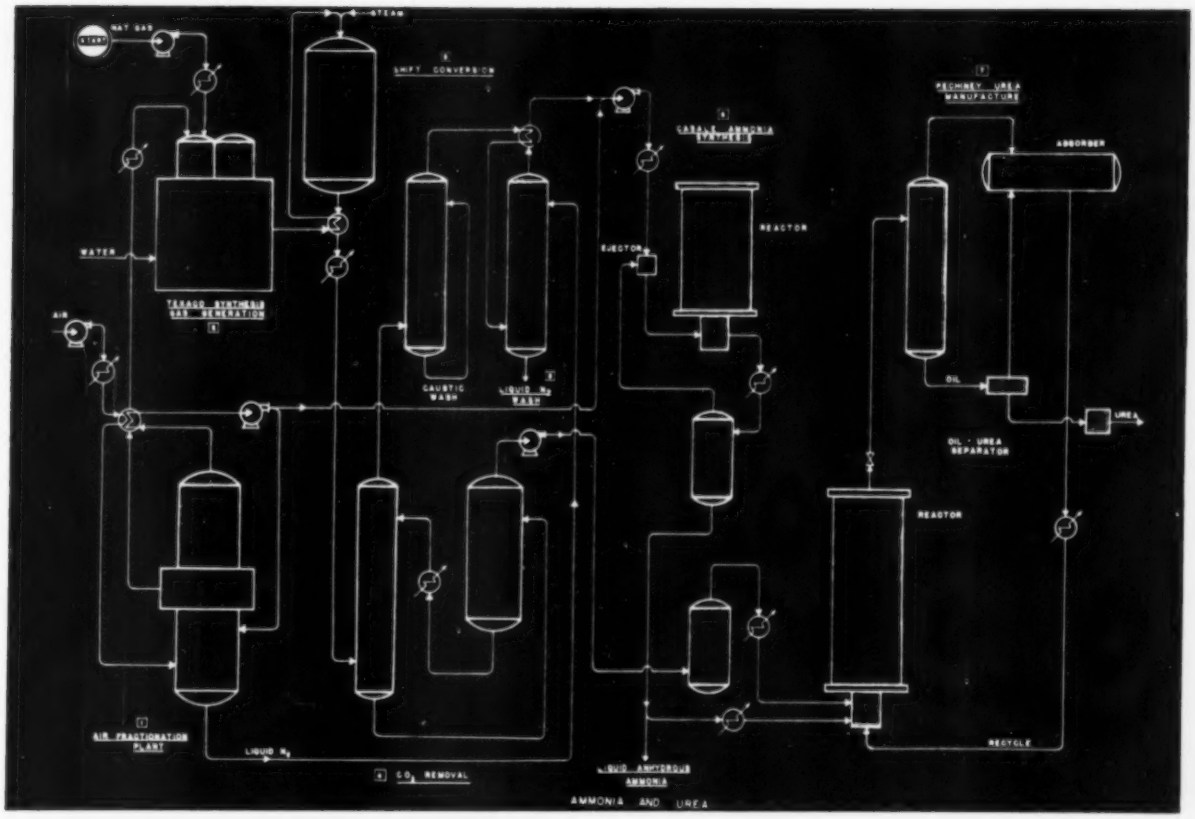
Liquid ammonia and liquid carbon dioxide are fed into the urea synthesis autoclave in the ratio of six moles of ammonia to one mole of carbon dioxide. In the autoclave one mole of carbon dioxide reacts with two moles of ammonia to form ammonium carbamate which in turn partially dehydrates to form urea. The reaction is shown by the following equation:

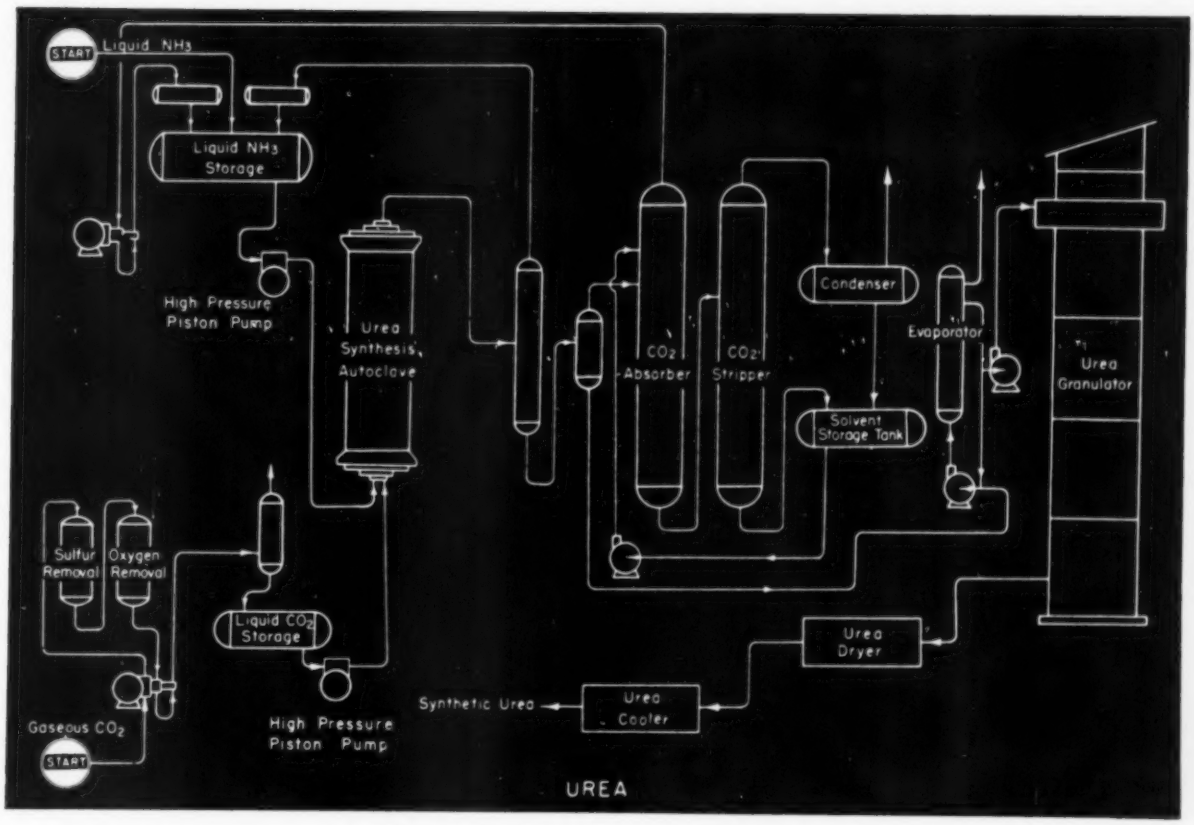
$$CO_2 + 2NH_3 \rightarrow \underset{\text{Ammonium Carbamate}}{H_2N\text{-}CO_2\text{-}NH_4} \rightarrow \underset{\text{Urea}}{H_2N\text{-}\overset{\overset{O}{\|}}{C}\text{-}NH_2} + H_2O$$

At the conditions prevailing in the reactor, a molal ratio of ammonia to carbon dioxide of 6:1 and a temperature of 175 C., the conversion of ammonium carbamate is approximately 76 percent. The reaction mixture leaving the autoclave, which consists of urea, water, ammonium carbamate and ammonia, undergoes a pressure reduction and flows to the recycle ammonia separator where most of the excess ammonia (four moles) is recovered at a pressure high enough to be condensed with the available cooling water. This liquefied ammonia is returned to the liquid ammonia storage tank.

The liquid reaction mixture freed of the excess ammonia undergoes another pressure reduction and enters the ammonium carbamate decomposer. In this equipment the unconverted ammonium carbamate is dissociated into the original feed materials, carbon dioxide and ammonia. The mixture of these two gases leaving the carbamate decomposer is sent to the carbon dioxide absorber where a solvent selectively absorbs the carbon dioxide from the gas mixture. This leaves a pure ammonia gas which is compressed, liquefied and returned to the liquid ammonia storage tank. The carbonated solvent passes through the carbon dioxide stripper where the solvent is regenerated by removing the absorbed carbon dioxide. The regenerated solvent is then returned to the carbon dioxide absorber.

The bottoms from the carbamate decomposer, which consists of an aqueous solution of urea, is fed to the evaporator where enough water is removed so that the solution is concentrated to 95 percent urea in water. This solution is pumped to the urea granulator. The urea emerges in the form of spherical granules which are dried to remove the remaining moisture and then cooled to insure a free-flowing product.


START
NAT GAS
STEAM
SHIFT CONVERSION
WATER
AIR
REACTOR
EJECTOR
ABSORBER
OIL
UREA
REACTOR
RECYCLE
AIR FRACTIONATION PLANT
LIQUID N_2
CO_2 REMOVAL
LIQUID ANHYDROUS AMMONIA
AMMONIA AND UREA


START
Liquid NH_3
Liquid NH_3 Storage
High Pressure Piston Pump
Urea Synthesis Autoclave
CO_2 Absorber
CO_2 Stripper
Condenser
Evaporator
Urea Granulator
Solvent Storage Tank
Sulfur Removal
Oxygen Removal
Liquid CO_2 Storage
Urea Dryer
Synthetic Urea
Urea Cooler
Gaseous CO_2
START
High Pressure Piston Pump
UREA

Anhydrous Hydrogen Chloride

THE GIRDLER COMPANY

APPLICATION: This process of producing anhydrous hydrogen chloride gas was developed by the Hooker Electrochemical Company and is offered through The Girdler Company of Louisville, Ky., as licensing agent.

CHARGE: The charge is hydrogen produced in a Hygirtol hydrogen plant (described in page 176) or from electrolytic cells and chlorine.

PRODUCT: A typical analysis of the finished gas is:

Hydrogen Chloride	99.00 percent
Chlorine	None
Hydrogen	0.64
Nitrogen	0.20
Water Vapor	0.10
Carbon Dioxide	0.05
Carbon Monoxide	0.01
Total	100.00

DESCRIPTION: A single burner installation for producing up to eight tons per day of anhydrous hydrogen chloride is shown. Liquid chlorine is vaporized at a pressure of 5 psig and piped to the HCl burner vessel. The hydrogen and chlorine must be metered carefully so as to avoid the possibility of forming explosive mixtures.

The two reactants are fed to a specially designed burner installed in the base of a water cooled combustion chamber where the reaction

$$H_2 + Cl_2 \rightarrow 2\,HCl$$

takes place. Essentially, all of the chlorine is reacted and 97 percent or more of the hydrogen. The purity of the product depends on the purity of initial reactants.

The gases are then cooled by a combination of air cooled pipes and a water cooled cascade cooler. When absolutely dry gas is required dehydration is effected by passing it through concentrated sulfuric acid recirculated in a glass lined, Raschig ring packed vessel. As the water content of the gas is low, sulfuric acid requirements are nominal. The pure gas is then available at essentially atmospheric pressure and may be used as such or compressed to the desired service pressure. A vent gas absorbing system is used to dispose of HCl and Cl_2 vapors on startups.

The advantages of this method of producing anhydrous hydrogen chloride over other industrial methods are as follows: (a) low capital investment required per ton of capacity, (b) low maintenance and operating cost, (c) high purity gas produced directly, (d) safer operation, (e) small capacity installations possible and economically feasible, (f) plant output may be readily varied to suit consumption, and (g) no by-product disposal problem.

YIELDS: Approximate raw material requirements for 2000 pounds of anhydrous hydrogen chloride are:

Chlorine	1950 pounds
Hydrogen	10,800 scf*

(*Standard cubic feet measured at 60 F. and 1 atm. These should be dry and at a minimum of 5 psig.)

The utility requirements per ton are as follows:

Cooling Water	4000-4500 gallons
Power	Nominal
Steam	Space heating only
Labor	⅓ manhour/hour
Misc. reagents for drying, etc.	Nominal

COMMERCIAL INSTALLATIONS: The first installation was made by Hooker Electrochemical Company in 1942. Since then several installations have been placed in operation by B. F. Goodrich Chemical Company at Louisville, Ky., and Calvert City, Ky., and Pennsylvania Salt Manufacturing Company at Calvert City, Ky.

Ammonium Nitrate

THE GIRDLER COMPANY

APPLICATION: A process for manufacturing fertilizer grade ammonium nitrate.

CHARGE: Anhydrous liquid ammonia.

PRODUCT: Prilled ammonium nitrate with a nitrogen content of 33.5 weight percent.

DESCRIPTION: First, ammonia is oxidized with air to produce oxides of nitrogen which are then absorbed in water to form nitric acid. The reactions may be written as follows:

$$4\,NH_3 + 5\,O_2 = 4\,NO + 6\,H_2O$$
$$2\,NO + O_2 = 2\,NO_2$$
$$3\,NO_2 + H_2O = 2\,HNO_3 + NO$$

Ammonium nitrate is then formed by the reaction of nitric acid with ammonia as follows:

$$NH_3 + HNO_3 = NH_4NO_3$$

The duPont process ammonia oxidation unit is shown. Anhydrous liquid ammonia is first vaporized and then mixed with clean, compressed air and passed over a platinum gauze catalyst at 100-psig pressure. This catalyst is contained in the converter and, as the reaction is highly exothermic, operates at a temperature requiring water jacket cooling.

The hot gas emerging from the converter is cooled by heat exchange. The cooled gas, consisting largely of oxides of nitrogen and water vapor, then goes to an absorber tower where steam condensate is used for absorption. A secondary oxidation reaction occurs in the tower with the bleaching air which is introduced to the absorber. The nitric acid produced passes through the bleach tray where oxides of nitrogen are stripped from the acid.

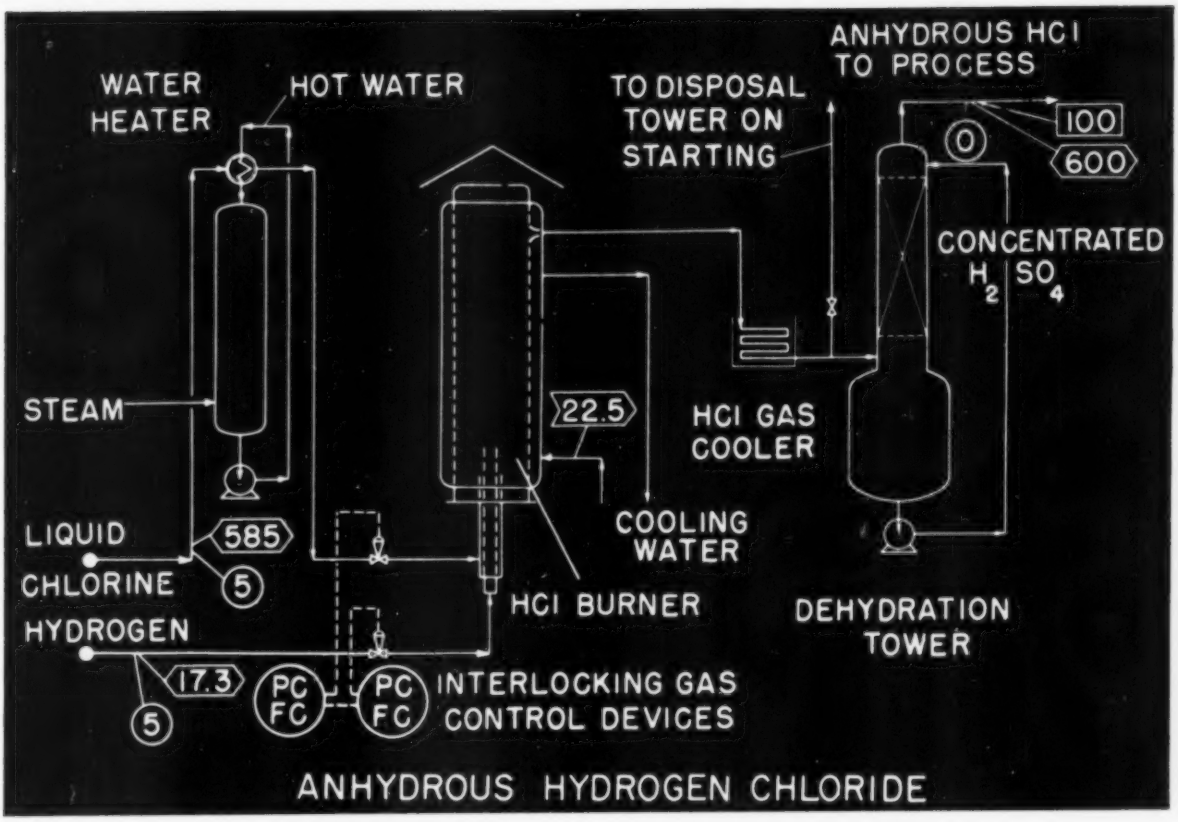
In the production of ammonium nitrate, the ammonia, as a vapor, and nitric acid streams are metered and controlled individually to give as close neutralization as possible. Under normal operation a solution of 83 to 85 percent ammonium nitrate may be attained by allowing the heat of reaction to evaporate the excess water. The solution then goes to a storage tank.

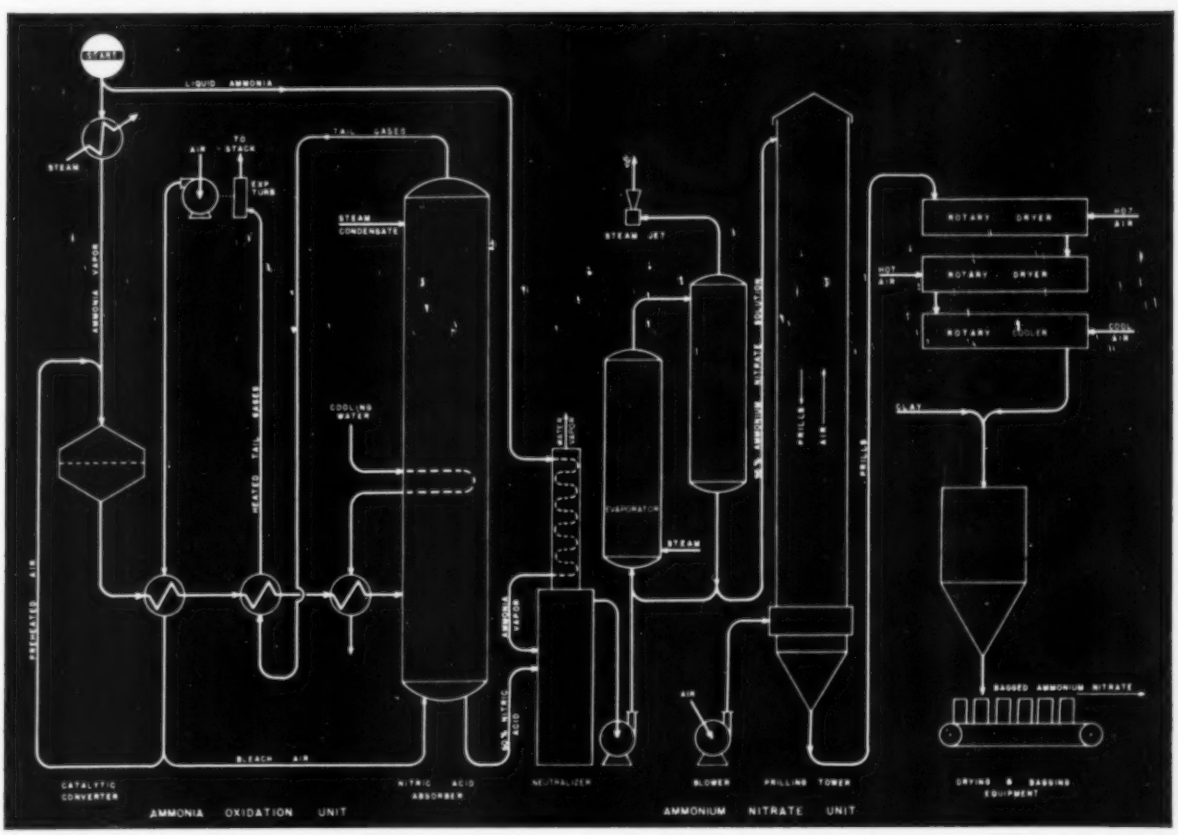
Before solidification the solution, known as weak liquor, is pumped to a vacuum evaporator equipped with internal steam coils where it is concentrated to about 95 percent ammonium nitrate. The prilling process for solidification is that of Canadian Patents and Development, Ltd. The 95 percent solution is pumped to the top of the prilling tower and sprayed countercurrent to an updraft of air. The free fall distance in the tower is greater than 100 feet. A wet granular salt is formed. Little or no moisture is lost in this process and the salt still has about 5 percent water.

The wet salt is dried in rotary kiln-type dryers. The salt then passes through a cooler using unheated air. At this point the moisture content is about 0.1 percent. The ammonium nitrate is mixed with four weight percent clay to prevent caking during storage.

YIELDS: The over-all yield of ammonia to ammonium nitrate is about 95 percent. This amounts to about 2.25 tons fertilizer per ton ammonia feed.

COMMERCIAL INSTALLATIONS: The first Girdler plant started operation for Mississippi Chemical Company, Yazoo City, Miss., in 1951. It has a capacity of 140 tons per day. A second installation, with a capacity of 330 tons per day, is being engineered for Cooperative Farm Chemicals Association, Lawrence, Kan.


ANHYDROUS HCl
TO PROCESS
WATER
HEATER
HOT WATER
TO DISPOSAL
TOWER ON
STARTING
100
0
600
CONCENTRATED
H_2SO_4
STEAM
22.5
HCl GAS
COOLER
LIQUID
CHLORINE
585
5
COOLING
WATER
HCl BURNER
DEHYDRATION
TOWER
HYDROGEN
17.3
5
PC
FC
PC
FC
INTERLOCKING GAS
CONTROL DEVICES
ANHYDROUS HYDROGEN CHLORIDE


LIQUID AMMONIA
STEAM
AIR
TO STACK
EXP. TURB.
TAIL GASES
STEAM CONDENSATE
AMMONIA VAPOR
HEATED TAIL GASES
COOLING WATER
STEAM JET
EVAPORATION
STEAM
PRILLER
AIR
ROTARY DRYER
ROTARY DRYER
ROTARY COOLER
HOT AIR
HOT AIR
COOL AIR
CLAY
BAGGED AMMONIUM NITRATE
CATALYTIC CONVERTER
NITRIC ACID ABSORBER
NEUTRALIZER
BLOWER
PRILLING TOWER
DRYING & BAGGING EQUIPMENT
AMMONIA OXIDATION UNIT
AMMONIUM NITRATE UNIT

Carbon Black

CONTINENTAL CARBON BLACK COMPANY

APPLICATION: A process for manufacturing furnace type carbon black.

CHARGE: Natural gas.

PRODUCT: Furnace type carbon black used primarily as reinforcing agents in rubber products or as a pigment in inks and paints.

DESCRIPTION: Carbon black is made by the high temperature cracking of natural gas or petroleum oil. The furnace blacks are divided according to feedstock as gas blacks or oil blacks.

In the gas furnace process natural gas and air are introduced simultaneously into the furnace through a number of parallel-slot burners, which distribute the air and gas in alternate parallel layers. Combustion at the air-gas interface provides the heat necessary to convert the remainder of the gas to carbon black. Furnace temperatures are about 2200-2300 F. depending on the grade of gas black being made. The combustion process is controlled by temperature which is a function of the air-to-gas ratio. The products of combustion, H_2, CO, CO_2, H_2O and carbon black, leave the furnace and enter the primary cooler from a long refractory-lined duct.

The effluent, either from the gas furnace or oil reactor is further cooled to about 550 F. by addition water sprays located in the primary cooler.

Several methods are used to separate the carbon black from the gas stream. Electrostatic precipitators can be used to agglomerate the carbon black particles so that they may be separated in cyclone collectors. Since this system collects only about 90 percent of the carbon black, secondary collectors may be added to insure virtually 100 percent collection efficiency. These may be either of two designs, a bag fiter or a wet collector. For wet collection, the gases are scrubbed with water in conventional equipment. The clean exhaust gas is discharged to the atmosphere, while the resulting carbon black-water slurry is drained into a clarifier. The effluent from the clarifier is returned to the wet collector while the heavier slurry from the bottom of the clarifier is sent through a grit separator and used as quench water in the primary cooler. The collection system shown in the flow diagram is somewhat different in that the agglomerating step is omitted. This method is used on some oil black installations.

A large part of the carbon black is collected in four cyclones placed in series following the primary cooler. The gases, with the remaining carbon black, enter a secondary cooler where the temperature is reduced from 500 to 275 F. by means of water sprays. The black is then collected by a bag filter.

The carbon black goes to small diameter collecting cyclones and then to a high speed hammermill. In the dry process system the fluffy carbon black feeds into a slowly rotating drum where it forms small pellets. In the wet process system the loose black is conveyed to a mixing box where it is mixed with water. The rotating action within the mixing box mixes the black and water to form small pellets. These are dried in a rotary kiln. The pellets from both systems are screened to remove the fines and then elevated to a storage tank. In either process, pelletizing increases the bulk density of the carbon black almost ten-fold and produces a product that is free flowing and relatively clean to handle.

Carbon Dioxide

THE GIRDLER COMPANY

APPLICATION: A process for manufacturing carbon dioxide.

CHARGE: Natural gas, fuel oil or any other carbonaceous fuel.

PRODUCT: Gaseous, liquid or solid carbon dioxide.

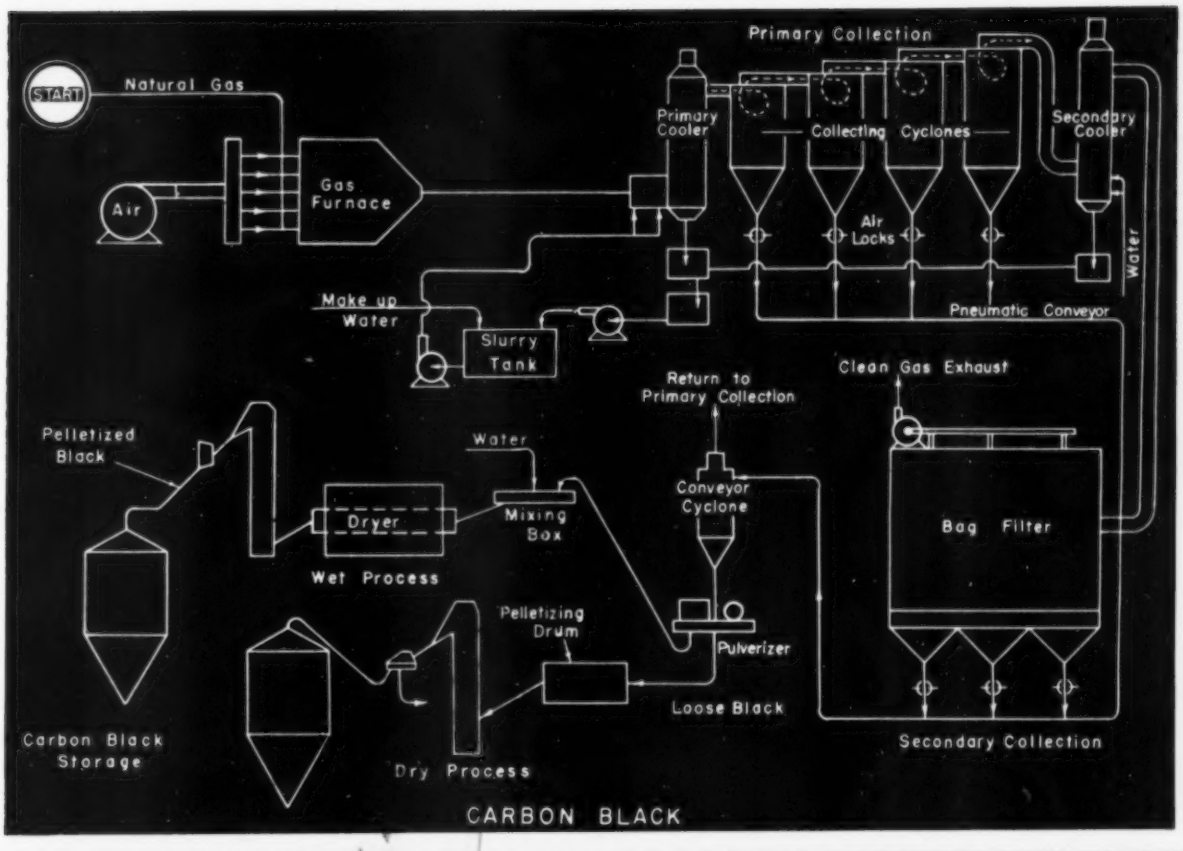
DESCRIPTION: The flowsheet on the opposite page is a simplified diagram of a typical plant for producing gaseous carbon dioxide from hydrocarbons. In this plant the fuel is burned under a standard water tube boiler for the production of 200 to 250 psig steam. The flue gases containing 10 to 15 percent carbon dioxide are taken from the boiler at 650 F. and passed through two packed towers where they are cooled and cleaned by water. After scrubbing, the cooled flue gases are fed into the base of the absorption tower. The Girbotol process, in which the carbon dioxide is absorbed selectively by a solution of ethanolamines passing counter current to the gas stream, is used for CO_2 recovery. The carbon dioxide-free flue gases are vented. The carbon dioxide bearing solution is fed to the top of a reactivation tower. Here the carbon dioxide is stripped from the amine solution by heat and the reactivated solution returns through the heat exchange equipment to the absorption tower. Carbon dioxide and steam pass out through the top of the reactivation tower into a gas cooler in which the steam condenses and returns to the tower as reflux. The carbon dioxide at this point is available as a gas at a pressure of about 30 psig.

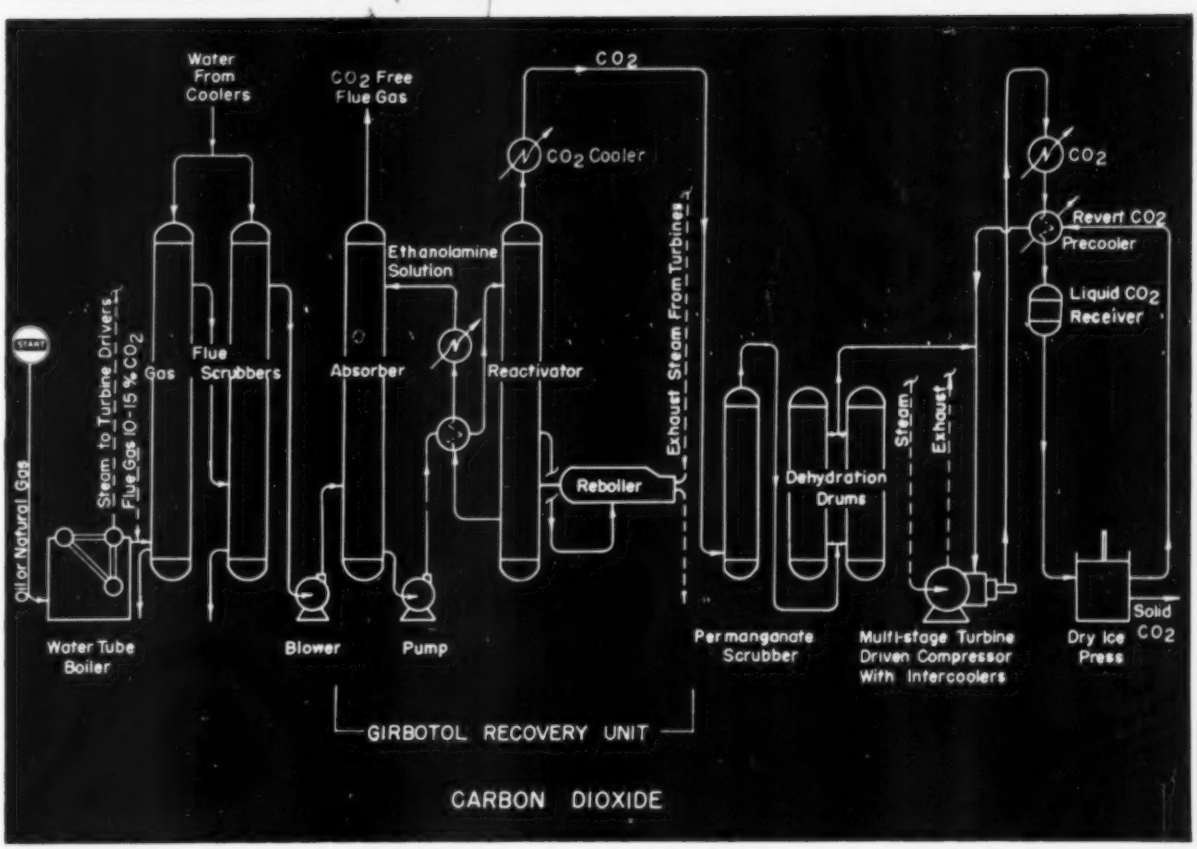
Traces of hydrogen sulfide and amine are removed from the carbon dioxide by use of a potassium permanganate solution buffered with sodium carbonate. To attain more efficient utilization of the permanganate solution it is customary to place two scrubbers in series with the more spent solution contacting the gas first. The carbon dioxide gas is then dehydrated in a dual-drum dry dessicant type unit prior to compression.

Two conditions are employed in commercial practice for liquefying CO_2. In the first method, liquefaction of the carbon dioxide is accomplished by compressing and cooling the gas until it is slightly below the critical temperature of 87.8 F. at a pressure of 73 atmospheres or more. Three or four stage compressors are used for this operation. The second method liquefies CO_2 by cooling the gas to 0 F.-20 F. with ammonia or other refrigerants.

The cycle shown on the flowsheet for producing solid CO_2 is a simple precooling cycle in which the liquid carbon dioxide from the condenser is cooled by heat exchange with revert gases from the dry ice press. The super cooled liquid carbon dioxide is metered into the dry ice press from the receiver under pressure until the correct amount is present. The revert gas line valve is opened which allows the pressure to be reduced to atmospheric pressure. Part of the carbon dioxide vaporizes under these conditions and is returned to the process as revert gas. The heat of vaporization causes the remaining carbon dioxide to solidify into a "snow" which is compressed hydraulically in the press into dense blocks of solid carbon dioxide, or "dry ice."

COMMERCIAL INSTALLATIONS: Solid carbon dioxide plants have been installed at Pure Carbonic, Inc., in Chicago in 1947 and at Union Oil Company of California, Santa Maria, Calif., in 1948. The Girbotol process has been in use in many commercial plants for carbon dioxide recovery since 1932.


Primary Collection
START
Natural Gas
Air
Gas Furnace
Primary Cooler
Collecting Cyclones
Secondary Cooler
Air Locks
Water
Pneumatic Conveyor
Make up Water
Slurry Tank
Return to Primary Collection
Clean Gas Exhaust
Pelletized Black
Water
Dryer
Mixing Box
Wet Process
Conveyor Cyclone
Bag Filter
Pelletizing Drum
Pulverizer
Loose Black
Carbon Black Storage
Dry Process
Secondary Collection
CARBON BLACK


Water From Coolers
CO2 Free Flue Gas
CO2
CO2 Cooler
CO2
Revert CO2 Precooler
Ethanolamine Solution
Liquid CO2 Receiver
START
Steam to Turbine Drivers
Flue Gas 10-15 % CO2
Flue Gas Scrubbers
Absorber
Reactivator
Exhaust Steam From Turbines
Oil or Natural Gas
Reboiler
Dehydration Drums
Steam
Exhaust
Water Tube Boiler
Blower
Pump
Permanganate Scrubber
Multi-stage Turbine Driven Compressor With Intercoolers
Dry Ice Press
Solid CO2
GIRBOTOL RECOVERY UNIT
CARBON DIOXIDE

Carbon Monoxide

THE GIRDLER COMPANY

APPLICATION: A process for producing high purity CO from hydrocarbons for use in synthesizing organic chemicals or for producing H_2 and CO mixtures for Fischer-Tropsch, Oxo, and methanol processes.

CHARGE: Natural gas, propane, butane or refinery gases.

PRODUCT: Carbon monoxide of approximately 99 percent purity or H_2 and CO mixtures varying from 25 to 90 percent CO.

DESCRIPTION: The process for producing high purity CO from natural gas is shown. If mixtures of H_2 and CO containing 90 percent or less CO are desired, the compressor and separation unit are not required.

Natural gas feedstock is desulfurized over activated carbon. The hydrocarbon is then mixed with steam and recycle CO_2 and passed over a nickel catalyst contained in vertical alloy tubes suspended in a combustion chamber. Temperature in the catalyst bed is about 1500 F. The steam-hydrocarbon reactions in this reformer furnace are:

$$CH_4 + H_2O = CO + 3\,H_2 \quad (1)$$
$$CH_4 + 2H_2 = CO_2 + 4\,H_2 \quad (2)$$

By introducing recycled CO_2, reaction (2) is suppressed and a greater yield of CO is attained. A typical furnace effluent composition, on a dry basis, is as follows:

CO	24.4 Volume Percent
H_2	70.0 Volume Percent
CO_2	5.4 Volume Percent
CH_4	0.2 Volume Percent
	100.0 Volume Percent

The CO:H_2 ratio may be varied by changing the amount of CO_2 recycled to the system. The composition shown is obtained by recycling all the CO_2 produced in reaction (2). If a higher ratio of CO to H_2 is desired, additional CO_2 may be added from the reformer furnace flue gases by use of the Girbotol process. Thus a 2:1 (H_2:CO) Fischer-Tropsch synthesis gas or a 1:1 (H_2:CO) Oxo synthesis gas may be produced.

The effluent gases are cooled to about 100 F. before CO_2 removal by the Girbotol process employing an aqueous solution of ethanolamines. The residual CO_2 amounts to less than 0.05 percent of the gas mixture. The CO_2 removed is recycled to the process.

For high purity CO, a low temperature separation process is employed which is similar to a double column air separation unit. This unit is not detailed on the flowsheet. The gas is first compressed. Residual CO_2 is then removed by caustic wash and dehydration effected in a dual-drum dessicant system. When using a two stage separation process with an expansion engine, a recycle stream rich in CO is obtained which is recycled through the compression system back to the process as shown.

A typical product purity attained in such units is as follows:

CO	98.6 Volume Percent
H_2	1.2 Volume Percent
CH_4	0.2 Volume Percent
Total	100.0 Volume Percent

COMMERCIAL INSTALLATIONS: The first high purity carbon monoxide unit of this type was put in operation for Rohm and Haas Company, Houston, in 1952. The first synthesis gas plant of this type for producing mixtures of carbon monoxide and hydrogen was placed in operation for the U. S. Bureau of Mines, Bruceton, Pa., in 1947.

Hydrogen

THE GIRDLER COMPANY

APPLICATION: A process for producing high purity hydrogen.

CHARGE: Natural gas, refinery gas, propane, butane and others.

PRODUCT: A typical analysis of the product is:

Component	Vol. Percent
Carbon dioxide	0.01
Carbon monoxide	0.00
Methane	0.10
Nitrogen	0.01
Oxygen	0.00
Hydrogen	99.88
	100.00

DESCRIPTION: A Hygirtol* hydrogen plant for manufacturing high-purity hydrogen from hydrocarbons and steam combines several well established steps into a unified, continuous, low-pressure process.

The flow diagram illustrates a plant using propane as process material and fuel. The propane is purified to remove sulfur compounds, and then reacted with steam at elevated temperatures (about 1500 F.) over a nickel catalyst to convert the hydrocarbon to hydrogen, carbon monoxide, and carbon dioxide. The decomposition of the hydrocarbon results in a hydrogen product containing less than 0.1 percent of residual hydrocarbon.

Chemical reactions occurring in the furnace are:

$$C_nH_{2n+2} + nH_2O = nCO + (2n+1)\,H_2 \quad (1)$$
$$C_nH_{2n+2} + 2NH_2O = nCO_2 + (3n+1)\,H_2 \quad (2)$$

Similar reactions occur with unsaturated hydrocarbons such as ethylene and propylene. Heat must be supplied to maintain the required temperatures.

The gases from the furnace are cooled to about 700 F. by the addition of steam and passed through an iron-oxide catalyst. The carbon monoxide reacts with steam to produce carbon dioxide and hydrogen.

About 90 to 95 percent of the carbon monoxide is converted to carbon dioxide under normal conditions.

The gas mixture from the converter is cooled and the carbon dioxide is removed by the Girbotol process. The hydrogen is then purified further to remove the residual carbon monoxide (about 1 percent). The carbon monoxide can be converted to carbon dioxide and removed, or to methane by the following reaction:

$$CO + 3H_2 = CH_4 + H_2O \quad (3)$$

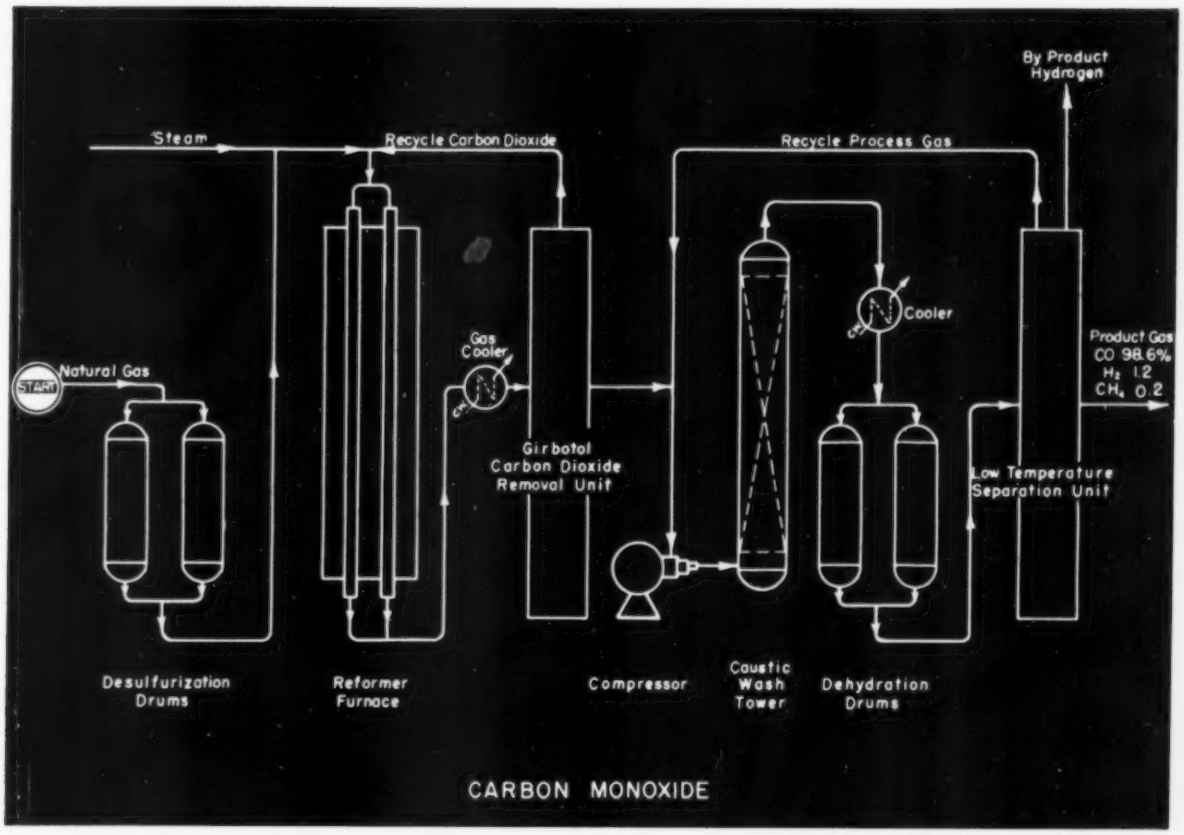
This reaction is exothermic and is carried out at slightly elevated temperatures in the presence of a catalyst.

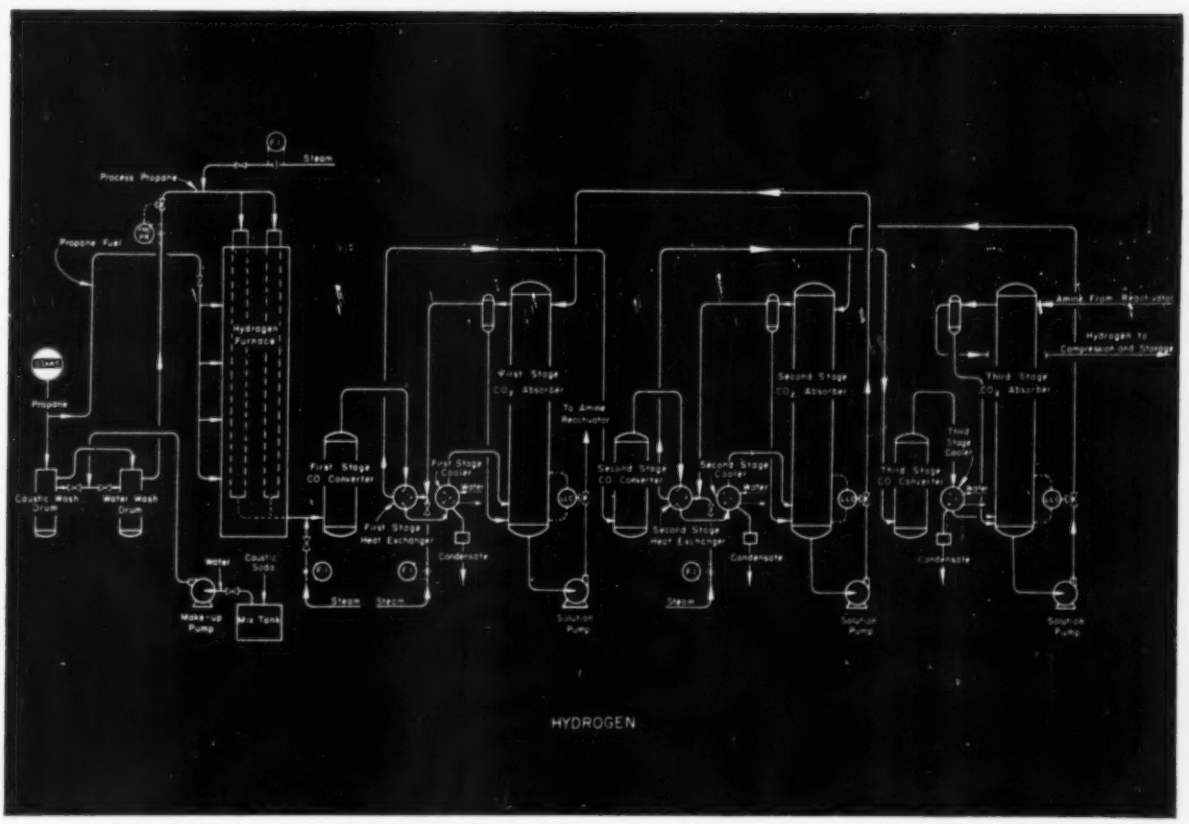
YIELDS: The material and utility requirements for producing 1000 cubic feet of high-purity hydrogen are:

Material or Utility	Quantity
Process Material:	
Propane, gallons	2.75
Or Natural Gas, cubic feet	250
Fuel (gas or oil) Btu	250,000
Steam, pounds	380
Cooling water, gallons (30 F. rise)	1600
Power, kwh	2
Chemicals, cost in cents	2

COMMERCIAL INSTALLATIONS: The first plant was placed in operation in 1944 for E. F. Drew and Co., Inc., at Boonton, N. J. Over 30 additional plants have been installed or are under design having a combined capacity over 11 million cubic feet of hydrogen per day.

*Hygirtol is a trade mark of The Girdler Company.


By Product Hydrogen
Steam
Recycle Carbon Dioxide
Recycle Process Gas
Cooler
Gas Cooler
Natural Gas
START
Girbotol Carbon Dioxide Removal Unit
Product Gas
CO 98.6%
H2 1.2
CH4 0.2
Low Temperature Separation Unit
Desulfurization Drums
Reformer Furnace
Compressor
Caustic Wash Tower
Dehydration Drums
CARBON MONOXIDE


Steam
Process Propane
Propane Fuel
Hydrogen Furnace
START
Propane
Caustic Wash Drum
Water Wash Drum
Water
Caustic Soda
Make-up Pump
Mix Tank
First Stage CO Converter
First Stage Heat Exchanger
First Stage Cooler
Condensate
Steam
First Stage CO2 Absorber
To Amine Regenerator
Solution Pump
Second Stage CO Converter
Second Stage Heat Exchanger
Second Stage Cooler
Second Stage CO2 Absorber
Third Stage CO Converter
Third Stage Cooler
Third Stage CO2 Absorber
Amine From Regenerator
Hydrogen to Compression and Storage
HYDROGEN

Hydrogen Cyanide

THE GIRDLER COMPANY

APPLICATION: A process applied to the manufacture of hydrogen cyanide. The reactor gas may also be used to produce alkali cyanides by absorbing hydrogen cyanide in caustic.

CHARGE: Natural gas and anhydrous ammonia are the charge.

PRODUCT: The product is gaseous hydrogen cyanide of 99 percent purity.

DESCRIPTION: Hydrogen cyanide is produced by the reaction of ammonia, natural gas and air over a platinum catalyst which may be represented as follows:

$$NH_3 + CH_4 + 1.5\ O_2 \rightarrow HCN + 3H_2O$$

A unique process developed by Freeport Sulphur Company is employed to separate the hydrogen cyanide from the side reaction gases and to allow the separate recovery of unreacted ammonia.

Ammonia and natural gas, under at least 5 to 10 psig pressure, are filtered to remove any scale which might foul the catalyst gauze and mixed prior to entering the converter vessel. The converter operates at 1800 F. and pressures slightly above atmospheric. The composition of the effluent gas is given below:

Composition of Gas Produced in Generator

	Mole Percent
Hydrogen Cyanide	5.9
Ammonia	1.6
Carbon Dioxide	0.2
Carbon Monoxide	4.4
Methane	0.5
Hydrogen	7.5
Oxygen	0.1
Nitrogen	56.7
Water Vapor	23.1
	100.0

The effluent gases are cooled immediately.

Of the ammonia fed to the converter approximately 67 percent is converted to hydrogen cyanide, 18 percent is dissociated to hydrogen and nitrogen and 15 percent passes through unreacted. As the majority of unreacted ammonia may be recovered and recycled, the over-all ammonia conversion to HCN is about 74 percent.

The separation system is based on the use of a polyhydroxy-boric acid complex. A solution of 8.3 weight percent pentaerythritol and 2.5 weight percent boric acid in water is used. This complex reacts with ammonia in the absorber which prevents polymerization of HCN. The HCN is absorbed by water. HCN is stripped from the absorber bottom stream in the HCN stripper. Residual ammonia is removed from the HCN stream by washing with fresh solvent. The product is then acid washed for final cleanup and delivered at atmospheric pressure. The HCN-free solution goes to the primary ammonia stripper where the polyhydroxy-boric acid complex dissociates and releases ammonia. The stripper operates at 25 psig pressure and 270 F. Some ammonia gas is liberated here, cooled and recycled to the HCN converter. The condensate from this gas stream is steam stripped in the secondary ammonia stripper where the bulk of the ammonia is recovered and recycled.

YIELDS: Raw materials and utilities for one pound of hydrogen cyanide, based on natural gas with 97 percent methane, are:

Ammonia	0.85 lbs.
Natural Gas	.28 scf
Steam (100 psig)	1.87 lbs.
Electric Power	0.14 kwh
Cooling Water	.56 gals.

If a larger proportion of C_2 and higher hydrocarbons are present, the yield of hydrogen cyanide is reduced somewhat.

COMMERCIAL INSTALLATION: The process has been developed through the pilot plant stage by Freeport Sulphur Company.

Oxygen

AIR PRODUCTS INC.

APPLICATION: This process is applied to the manufacture of oxygen.

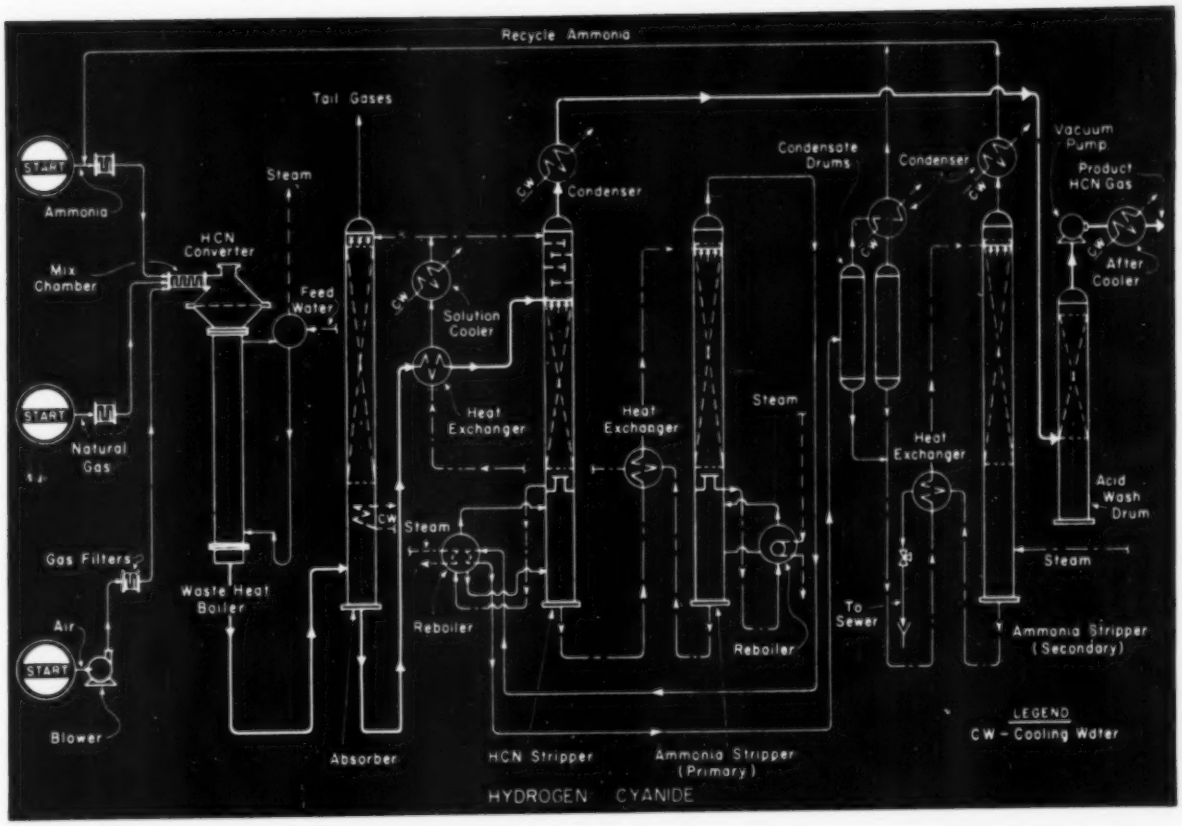
CHARGE: The charge is air.

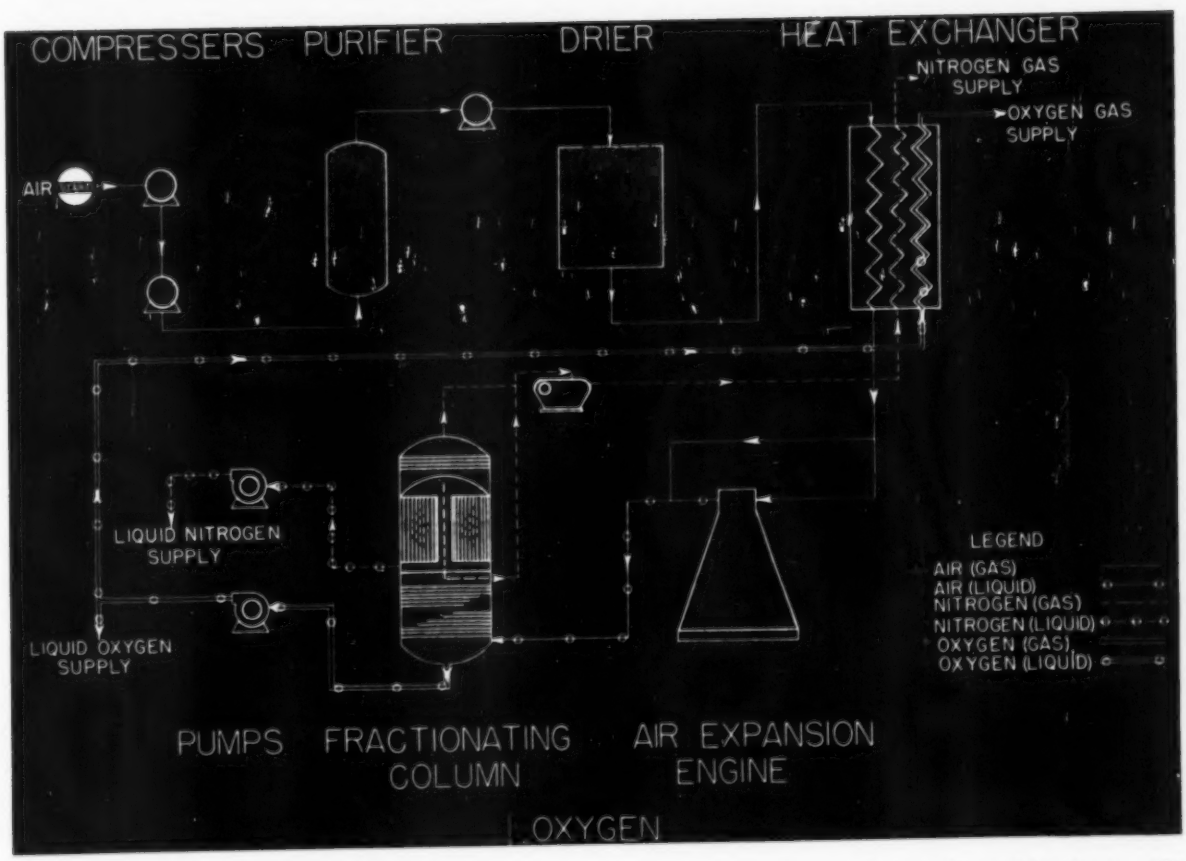
PRODUCT: Liquid oxygen, liquid nitrogen and gaseous oxygen or nitrogen can be produced. Liquid oxygen and liquid nitrogen are not usually produced simultaneously.

DESCRIPTION: The oxygen-nitrogen generator consists of the following components: Air compressors, air purifiers, air driers, expansion engine, heat interchanger, fractionating column, delivery pumps. Physically, the expansion engine, heat exchanger, column and pumps are combined into a single unit.

The air is compressed and carbon dioxide removed in a chemical or low-temperature freeze-out purifier (the latter for large scale units only.) The air is further compressed (to a maximum of 3000 psi in some plants) and water vapor removed in a bed of activated alumina. The high-pressure air is cooled by heat exchange with the outgoing streams of oxygen and nitrogen, and is expanded and further cooled by doing work in an expansion engine, the air leaving the engine at a pressure of about 100 psi. Further throttling takes place in the tower, which the air enters as a liquid-gas mixture. Liquid oxygen is collected at the bottom of the tower, gaseous nitrogen at the top. The degree of purity depends on the tower design and the extent of reflux. The compact liquid oxygen-nitrogen pumps make possible the delivery of oxygen or nitrogen in the liquid or gaseous form at any desired pressure up to about 3000 psi, and eliminate the usual oxygen compressor and gas holder. If liquid oxygen is pumped, it is subcooled below its boiling point by cold nitrogen vapor. If liquid nitrogen is the desired end product, another distillation column is required, and the cold nitrogen gas must be liquefied by heat exchange with a subcooled liquid oxygen-nitrogen mixture. Oxygen-nitrogen generators fall into two classes, high purity (over 99.5 percent) and tonnage (80-95 percent purity). High-purity oxygen is used in industry for welding, cutting, scarfing and improving combustion in furnaces. Tonnage oxygen is used in the petrochemical industry for the partial oxidation of natural gas and for other chemical syntheses.

COMMERCIAL INSTALLATIONS: Plants of this type have been built in units as large as 500 tons per day. Among the installations is Spencer Chemical Company's unit at Vicksburg, Miss.


Recycle Ammonia
Tail Gases
Steam
Condenser
Condensate Drums
Condenser
Vacuum Pump
Product HCN Gas
After Cooler
START
Ammonia
HCN Converter
Mix Chamber
Feed Water
Solution Cooler
Heat Exchanger
Heat Exchanger
Steam
Heat Exchanger
START
Natural Gas
Acid Wash Drum
Steam
Gas Filters
Steam
Waste Heat Boiler
Reboiler
To Sewer
Ammonia Stripper (Secondary)
Air
START
Reboiler
LEGEND
CW - Cooling Water
Blower
Absorber
HCN Stripper
Ammonia Stripper (Primary)
HYDROGEN CYANIDE


COMPRESSERS
PURIFIER
DRIER
HEAT EXCHANGER
NITROGEN GAS SUPPLY
OXYGEN GAS SUPPLY
AIR
LIQUID NITROGEN SUPPLY
LIQUID OXYGEN SUPPLY
LEGEND
AIR (GAS)
AIR (LIQUID)
NITROGEN (GAS)
NITROGEN (LIQUID)
OXYGEN (GAS)
OXYGEN (LIQUID)
PUMPS
FRACTIONATING COLUMN
AIR EXPANSION ENGINE
OXYGEN

Hydrazine

APPLICATION: A process for manufacturing hydrazine.

CHARGE: Dilute caustic soda (eight percent); chlorine; ammonia.

PRODUCT: Hydrazine (N_2H_4); hydrazine hydrate ($N_2H_4 \cdot H_2O$) of 95-100 percent strength.

DESCRIPTION: Chlorine and dilute caustic are mixed in a reaction vessel to produce an aqueous sodium hypochlorite (NaOCl) solution. About ten percent excess caustic is used which amounts to a weight ratio of contained $NaOH:Cl_2$ of 1.25:1. For eight percent caustic the resulting hypochlorite strength is about 70 grams per liter available chlorine. The solution is pumped to the charge tank, from which it is fed continuously to process.

Anhydrous ammonia is dissolved in purified water to form a 28 weight-percent solution. This material is mixed with a recycle solution of the same strength and placed in a charge tank to be fed to process.

Ammonia and hypochlorite solutions are combined in a molar ratio considerably greater than the 2:1 stoichiometric requirement. Ratios as high as 20-50 NH_3:NaOCl have been used. The mixture is pumped to a pressure of 30 atmospheres, preheated to 320 F. in a steam heat exchanger, and passed quickly through the tubular reactor.

The successive reactions which occur are:

$$NaOCl + NH_3 \rightarrow NH_2Cl + NaOH$$
$$NH_2Cl + NH_3 \rightarrow N_2N \cdot NH_2 + HCl$$

The over-all reaction is quite rapid under the elevated-temperature conditions, the residence time being a matter of a few seconds. The elevated pressure is provided to prevent loss of ammonia. Conversion of hypochlorite is practically complete. With regard to yield, it has been found that certain metallic ions, particularly copper ions, catalyze side reactions which form ammonium chloride instead of hydrazine. It is necessary to use carefully purified water in the mixing and adjustment of concentration of the reactant solutions, and at the same time employ a purified gelatin inhibitor. With sufficient amounts of this inhibitor the hydrazine yields across the reactor are in the range of 80-90 percent.

The effluent from the reactor contains about 1.5 percent hydrazine in an aqueous solution together with NaCl, NaOH, unconverted ammonia, and minor amounts of side reaction products. The liquid is flashed to a pressure slightly above atmospheric with resulting liberation of ammonia and small amounts of hydrazine. The latter is recovered in a scrubbing tower which is irrigated by ammonia solution. The liquid from the flash chamber is combined with the bottoms stream from the scrubbing tower and fed to a fractionating column.

The purpose of this fractionator is to remove residual ammonia from the solution. A sufficient amount of water is taken overhead to form a combined recycle ammonia solution of about 28 weight-percent strength. The recycle stream is combined with fresh solution in the charge tank.

The bottoms from the ammonia tower contain the major impurities NaCl (5-6 percent) and NaOH (minor amount). The concentration of hydrazine hydrate ($N_2H_4 \cdot H_2O$) is about three percent. NaCl and NaOH are removed by salting-out in an evaporator. Crystallized NaCl, containing the NaOH, is collected in a filter tank and withdrawn periodically. The vapors from the evaporator contain 6-8 percent hydrazine hydrate.

Further concentration of the hydrate is effected in a series of three distillation columns. The concentration becomes in turn 15 percent, 40-45 percent, and 95-100 percent hydrate. The intermediate strengths have certain commercial uses. The final tower, which produces concentrated hydrate bottoms material, is kept under a nitrogen blanket to minimize explosion dangers. Operating personnel are protected from equipment handling concentrated hydrate solutions by thick concrete barriers.

It is not possible to produce anhydrous hydrazine by simple distillation since water and hydrazine form an azeotrope at 58.5 mole percent hydrazine. This difficulty may be circumvented by the addition of xylene to the hydrate and the water then removed by distillation. Another method for concentration is long refluxing with strong caustic. Other methods, such as chemical separation, fractional crystallization, and liquid-liquid extraction have been proposed but are not in use commercially.

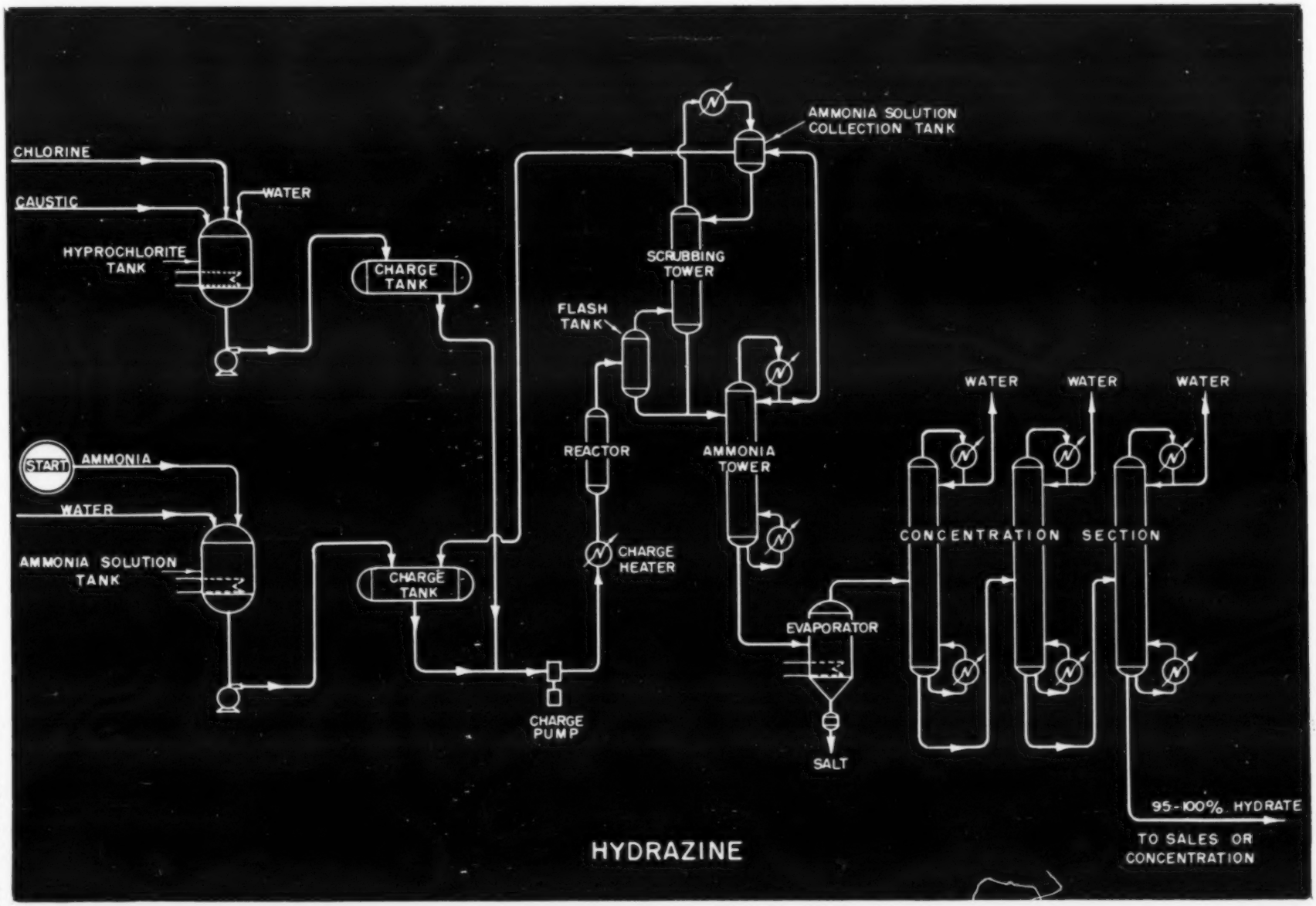
Stainless steel is used in all equipment past the ammonia-removal stage. Mild steel is satisfactory for the reaction section. Conventional materials of construction are used in other sections, e.g., in the hypochlorite tank. The product hydrazine, both anhydrous and hydrated, is shipped in stainless steel drums.

The product anhydrous hydrazine is a somewhat unstable liquid, an endothermic compound capable of decomposing with extreme violence. It is readily oxidizable. This combination of properties makes it of great importance as an explosive and as a fuel. Its most important present use is as a constituent in rocket and jet fuels; however, it has a great many other potential uses because of its reactive chemical nature.

OPERATING CONDITIONS: Given in above text.

YIELDS: Over-all process yields of 70-75 percent are obtained, based on available chlorine raw material.

COMMERCIAL INSTALLATIONS: The only large-scale plant in this country is that of Mathieson Chemical Corporation at Lake Charles, La. This plant utilizes the process described above. The only other plant, that of Fairmount Chemical Company, Newark, N. J., utilizes a slightly-altered process (urea is substituted for ammonia as the nitrogen source) on a small scale.


CHLORINE
CAUSTIC
WATER
HYPROCHLORITE TANK
CHARGE TANK
AMMONIA SOLUTION COLLECTION TANK
SCRUBBING TOWER
FLASH TANK
START
AMMONIA
WATER
AMMONIA SOLUTION TANK
CHARGE TANK
REACTOR
CHARGE HEATER
AMMONIA TOWER
WATER
WATER
WATER
CONCENTRATION SECTION
EVAPORATOR
CHARGE PUMP
SALT
95-100% HYDRATE
TO SALES OR CONCENTRATION
HYDRAZINE

Sulfur Recovery

THE GIRDLER COMPANY

APPLICATION: The process is applied to the recovery of elemental sulfur from hydrogen-sulfide bearing gases.

CHARGE: Although the acid gas stream from a Girbotol plant is an ideal feed material, almost any hydrogen sulfide or hydrogen sulfide and carbon dioxide gas mixture may be employed.

PRODUCT: The quality of the sulfur is equal to or better than bright Gulf Coast sulfur.

DESCRIPTION: The process is based on a modification of the original Claus process for carrying out the highly exothermic reaction:

$$H_2S + 1/2O_2 \rightarrow S + H_2O$$

In order to remove the heat generated more efficiently and maintain better control over the process the above reaction is carried out in two steps as follows:

$$(1)\ H_2S + 3/2O_2 \rightarrow SO_2 + O^2H$$
$$(2)\ 2H_2S + SO_2 \rightarrow 3S + 2H_2O$$

The accompanying flow plan is typical of a two stage plant and shows the approximate temperatures for a feed gas containing about 90 percent hydrogen sulfide. Reaction (1) takes place in the combustion chamber of a fire-tube boiler where approximately one-third of the hydrogen sulfide is burned to sulfur dioxide.

Following the steam boiler the gases pass through the first converter where most of reaction (2) takes place and a gas temperature rise results. It is estimated that 70-80 percent of the sulfur recovered is formed in the first stage and the balance in the second after intermediate product removal. The catalyst employed is activated bauxite which has an indefinite life, being subject only to mechanical failure.

In order to remove the sulfur formed in the first converter the gases are cooled to approximately 300 F. and the sulfur condensed. The gases are reheated before entering the second converter. Final cooling and condensation after the second converter take place in a carbon steel, Raschig ring packed scrubber where the hot gases pass countercurrent to liquid sulfur. The circulating sulfur, heated in the scrubber, returns to the sulfur tank carrying with it the newly formed sulfur. The tail gases largely consist of nitrogen, water vapor, carbon dioxide (if present originally), and small percentages of unreacted hydrogen sulfide and sulfur dioxide.

YIELD: Generally a minimum of 90 percent of the sulfur present in the hydrogen sulfide may be recovered in a two-stage plant, and up to 95 percent recovery is readily attained in commercial practice. However, a single-stage plant, designed to recover 80-85 percent of the hydrogen sulfide as sulfur, may prove more economical for smaller capacity installations.

COMMERCIAL INSTALLATIONS: Plants are operating at the Freeport Sulphur Company, Westville, N. J., and at Stanolind Oil and Gas Company, North Cowden, Texas. A new plant is under design for a subsidiary of Standard Oil Company (New Jersey) at Aruba, Netherlands West Indies.

Monochlorobenzene and DDT

MONSANTO CHEMICAL COMPANY

APPLICATION: This process is applied to the manufacture of monochlorobenzene and DDT.

CHARGE: Nitration grade benzene and chlorine are charged to make monochlorobenzene. Ethanol, chlorine, 99.5 percent sulfuric acid and monochlorobenzene are the charge for making DDT.

PRODUCT: Monochlorobenzene of 1 C. boiling range and DDT (1 trichloro-2, 2-bis ethane).

DESCRIPTION:

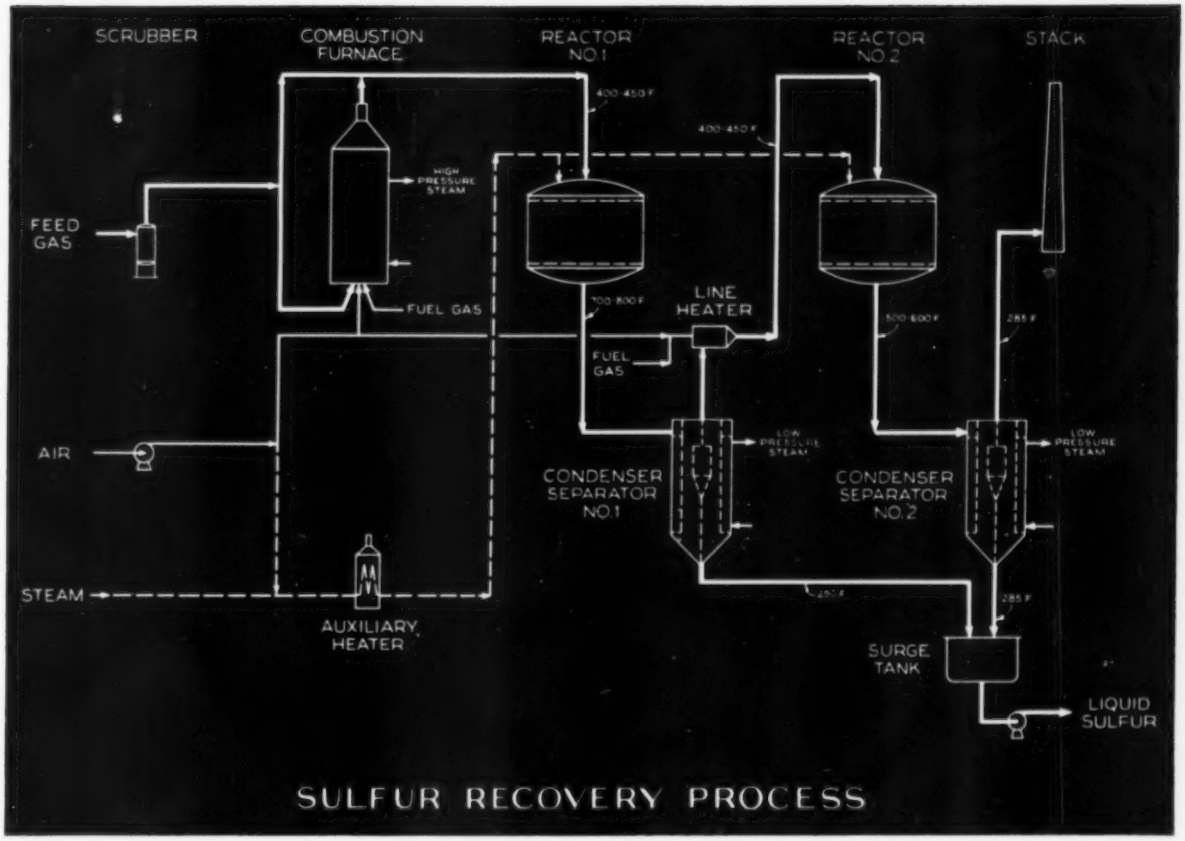
Monochlorobenzene. Dry nitration grade benzene is continuously chlorinated to the desired degree of chlorination. The temperature and composition of the chlorination mass are controlled to obtain the desired mono-dichlorobenzene ratio. Off gases from the chlorination pass through the scrubbing towers to the HCl recovery area. The chlorination mass flows by gravity into the stabilizers.

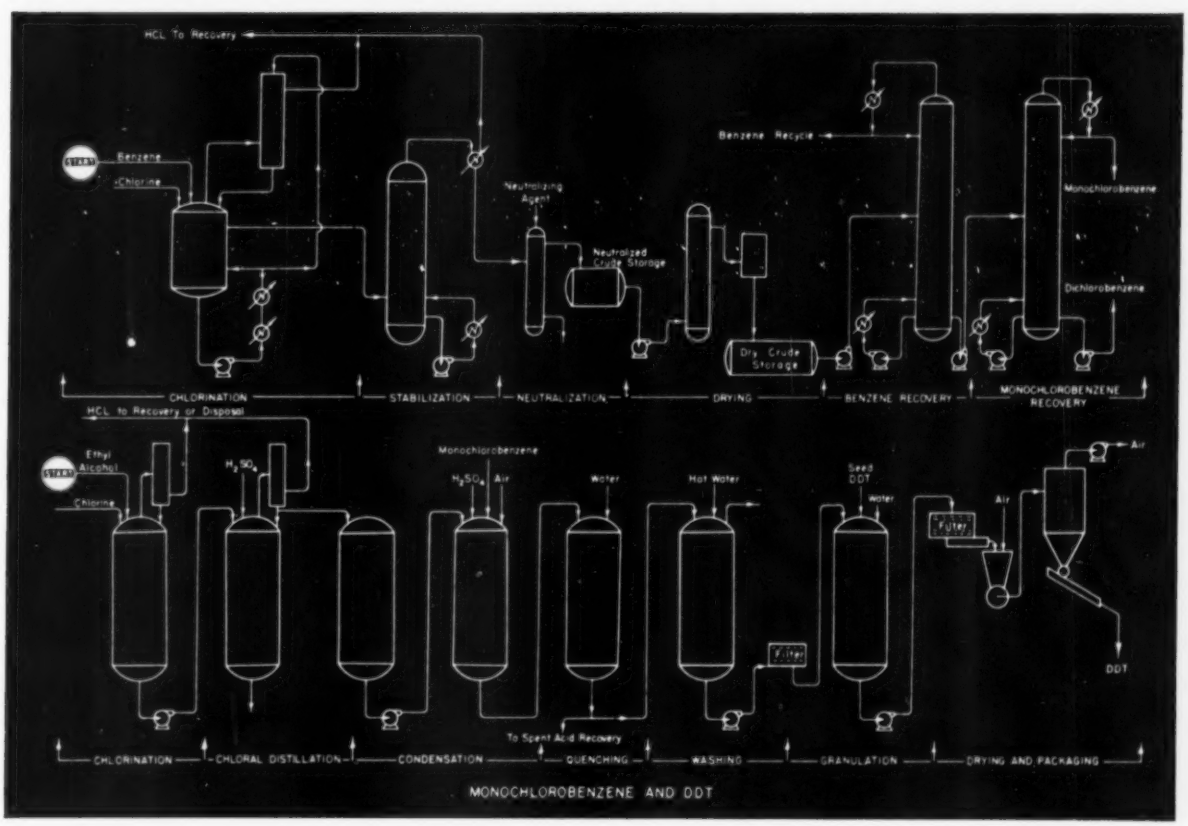
Here, the chlorination mass is flash distilled, removing the dissolved solids and HCl. The acid crude chlorination mass is condensed, cooled, neutralized, filtered, and dried before entering the distillation area. In the benzene columns, the benzene is separated from the chlorobenzenes and recycled to process. The crude chlorobenzenes from the bottom of the benzene columns are fed into the monochlorobenzene columns where the monochlorobenzene is separated from the dichlorobenzenes. The monochlorobenzene produced is specification grade and used in many processes including the manufacture of DDT. The dichlorobenzenes from the bottom of the column are further processed if separation of the isomers is desired.

DDT. DDT is produced by the condensation of chloral and monochlorobenzene. Chloral is prepared by the batchwise chlorination of 95 percent ethyl alcohol with vaporized chlorine in a jacketed glass-lined vessel. A mixture of chloral and chloral hemiacetal results from this reaction which is exothermic and requires cooling of the reactor. The chlorination is complete when the reaction mixture reaches the desired specific gravity. Ethyl chloride and hydrogen chloride are by-products.

The reaction mixture is delivered to a glass-lined still equipped with reflux type condensers where it is mixed with 96-97 percent spent sulfuric acid. The distillation is carried out over the sulfuric acid and the refined chloral obtained is fed to a glass-lined vessel where it is condensed with monochlorobenzene in the presence of sulfuric acid. The chloral and monochlorobenzene are added simultaneously to the reactor and cooled. Sulfuric acid (99.5 percent) is then added at a controlled rate while maintaining the reaction at a low temperature. Upon completion of the reaction, the slurry of spent acid and DDT is sent to a quencher for spent acid removal. The spent sulfuric acid is used in the distillation of crude chloral or refortified and re-used.

Any residual acid is then removed from the DDT by a water wash after which the DDT is melted with hot water and transferred to the washer. The DDT in the molten state is then successively washed with water, a sodium carbonate solution and finally with water. The molten DDT is then granulated by spraying into water seeded with DDT. The granulation slurry consisting of DDT granules and water is filtered to remove the water. The granules are milled and flash dried. The DDT obtained has a minimum set point of 89 C.


SCRUBBER
COMBUSTION FURNACE
REACTOR NO.1
REACTOR NO.2
STACK
400-450 F
400-450 F
HIGH PRESSURE STEAM
FEED GAS
FUEL GAS
700-800 F
LINE HEATER
500-600 F
285 F
FUEL GAS
AIR
LOW PRESSURE STEAM
LOW PRESSURE STEAM
CONDENSER SEPARATOR NO.1
CONDENSER SEPARATOR NO.2
450 F
285 F
STEAM
AUXILIARY HEATER
SURGE TANK
LIQUID SULFUR
SULFUR RECOVERY PROCESS


HCL To Recovery
Benzene
Chlorine
Neutralizing Agent
Neutralized Crude Storage
Benzene Recycle
Monochlorobenzene
Dichlorobenzene
Dry Crude Storage
CHLORINATION
STABILIZATION
NEUTRALIZATION
DRYING
BENZENE RECOVERY
MONOCHLOROBENZENE RECOVERY
HCL to Recovery or Disposal
Ethyl Alcohol
Chlorine
H_2SO_4
Monochlorobenzene
H_2SO_4
Air
Water
Hot Water
Seed DDT
Water
Air
Air
Filter
Filter
DDT
To Spent Acid Recovery
CHLORINATION
CHLORAL DISTILLATION
CONDENSATION
QUENCHING
WASHING
GRANULATION
DRYING AND PACKAGING
MONOCHLOROBENZENE AND DDT

Polyethylene

APPLICATION: A process for the continuous manufacture of polyethylene.

CHARGE: Ethylene gas of 90-95 percent purity.

PRODUCT: Solid polyethylene.

DESCRIPTION: The usual ethylene plant product contains 90-95 mole percent ethylene, the remainder being methane and ethane. This material must be up-graded before it can be used for polyethylene manufacture. Minimum specifications call for ethylene of 99.8-99.9 percent purity.

Charge ethylene gas is fed to a fractionating tower wherein a methane-ethylene mixture is separated as overhead product and returned to the ethylene plant for reprocessing. The operating pressure of this tower is 400-500 psi. A minimum amount of ethylene is allowed to pass overhead, commensurate with available refrigeration for condensing reflux. The bottoms product from this tower flows to a second tower, from which 99.8-99.9 percent ethylene is taken overhead. The bottoms from the second tower are returned to the ethylene plant for their ethane value.

A small quantity of oxygen is added to the high-purity ethylene, and the mixture is compressed to reaction pressure. The pressure level varies with the type of process used, as will be explained below. Compression of the charge gas is carried out in conventional equipment.

In the mass polymerization process, an operating pressure of about 1500 atmospheres is used. About 600 ppm oxygen in the reactor charge serves as catalyst. The mixture is heated to 375 F. and fed to a stainless-steel tubular reactor. The reaction is relatively slow and a long coil length is required. The reaction proceeds in the dense-gas phase with about 25 percent of the ethylene being converted to high molecular weight polymer. The exothermic heat of polymerization is quite intense and constitutes a major design problem. Special means are provided to maintain essentially isothermal conditions of 375 F.

The effluent from the reactor passes to a separator vessel in which unconverted ethylene is removed and recycled to an intermediate stage of the charge gas compressor. This ethylene contains no oxygen which, though serving as catalyst or initiator, is consumed in the reaction.

The liquid from the separator is water-white polyethylene with a viscosity about that of molasses. It is chilled quickly, and solidifies in the vicinity of 230 F. Final steps in the process are chopping, bin storage, sacking, and shipping.

In the solvent polymerization process, an operating pressure of about 1000 atmospheres is used. Solvents are generally water or aromatic hydrocarbons, the purpose of the solvent being to dissipate the heat of polymerization without limiting chain length.

A mixture of fresh and recycle ethylene, plus about 20 ppm oxygen catalyst, is dissolved in a benzene-water mixture at 375 F. The major constituents in the charge have a weight ratio of about 1.0:1.0:1.5 ethylene:benzene:water. The water contains 100 ppm oxygen. The charge is fed to a stainless-steel tubular reactor and during the course of reaction additional water is injected to maintain a more constant catalyst concentration throughout the reactor. About 17 percent of the ethylene is converted to polymer. Isothermal conditions of 375 F. are maintained.

The effluent from the reactor passes to a separator in which unconverted ethylene is removed and recycled as in the mass process. The liquid, consisting of polymer, benzene, and water is sent to a distillation unit in which benzene and water are ultimately separated from the heavier polymer.

The separated polymer passes through final processing steps of chilling, chopping, etc., as described above for mass-polymerized ethylene.

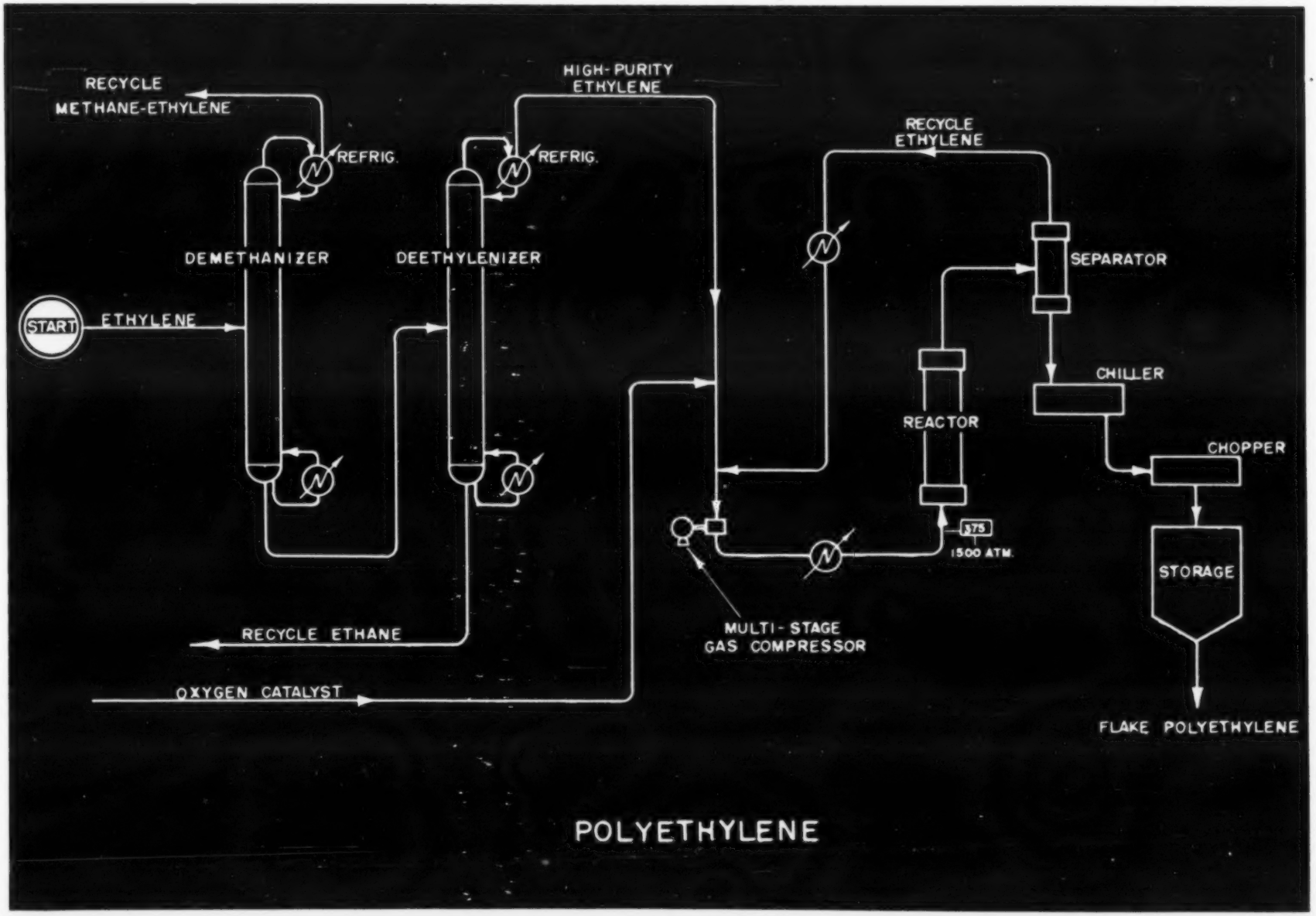
The product polymer has a molecular weight of 18,000-30,000 and a number of distinctive physical properties which make it of rapidly-increasing importance in the field of synthetic resins. Foremost of these properties are low electrical conductivity and flexibility without the use of plasticizers. Its chemical inertness is also of great importance. It may be extruded, compression-molded, or injection-molded.

The typical processes described above are subject to variations imposed by the particular properties of polymer desired and the research findings of individual producers. Catalysts other than oxygen may be used, the more important being organic peroxides and alkali metals. Operating pressures range from 1000 to 2000 atmospheres. Tower-type as well as tubular-type reactors may be used. Special alloys may take the place of stainless steel at critical points in the process.

OPERATING CONDITIONS: The major operating variables in the polymerization reaction are temperature, pressure, and catalyst concentration. Typical values of these variables are given in the above text.

YIELDS: The over-all process yield of polyethylene from ethylene is quite high, on the order of 98-99 percent.

COMMERCIAL INSTALLATIONS: Carbide and Carbon Chemicals Corporation, Charleston, W. Va.; Texas City, Texas; Seadrift, Texas (under construction); Torrance, Calif. (under construction). E. I. duPont de Nemours & Company, Orange, Texas. Canadian Industries, Ltd., Edmonton, Canada. Spencer Chemical Company, Orange, Texas (under construction). The Dow Chemical Company, Freeport, Texas (under design). Texas Eastman Company, Longview, Texas (under design). Monsanto Chemical Company, probably Texas City (under design).


RECYCLE
METHANE-ETHYLENE
REFRIG.
HIGH-PURITY
ETHYLENE
REFRIG.
RECYCLE
ETHYLENE
DEMETHANIZER
DEETHYLENIZER
SEPARATOR
START
ETHYLENE
CHILLER
REACTOR
CHOPPER
375
1500 ATM.
STORAGE
RECYCLE ETHANE
MULTI-STAGE
GAS COMPRESSOR
OXYGEN CATALYST
FLAKE POLYETHYLENE
POLYETHYLENE

Polybutene

APPLICATION: Processes for manufacturing solid and liquid polybutene (polyisobutylene).

CHARGE: Refinery C_4 hydrocarbon fraction.

PRODUCT: Solid polybutene, 200,000 molecular weight; liquid polybutene, 10,000 molecular weight.

DESCRIPTION: Polybutene is polymerized isobutylene of varying molecular weight. Two general types of polybutene are produced commercially: the solid, rubber-like high polymer and the viscous liquid low polymer. Typical processes for producing both types will be described briefly.

The specific raw material for the polymerization is 98 percent isobutylene. This can be obtained from refinery C_4s by an isobutylene extraction process described in this handbook.

For high-polymer production, isobutylene is dried and chilled to —150 F. in successive ammonia and ethylene refrigerant exchangers. It is then mixed with liquid ethylene (1:1 ratio), also at —150 F., and fed continuously to the reactor. A second stream of liquid ethylene, containing about 0.1 percent boron trifluoride catalyst, is fed to the reactor simultaneously. The reactor is a vertical vessel provided with means for violent agitation.

The polymerization reaction is rapid and exothermic. Heat removal is provided by vaporization of ethylene. Operating conditions are about —140 F. and atmospheric pressure. A solution polymerization technique of this nature produces a polymer of about 200,000 average molecular weight.

The effluent passes to a flash drum maintained at +150 F. where unreacted isobutylene, ethylene, and catalyst are removed. Water is added to the residue and the slurry passed through screens where most of the water is removed. The wet polymer is dried at 150-220 F. in a tunnel drier, and finally extruded. The final product is a close kin of butyl rubber, which contains small amounts of polymerized isoprene.

For low polymer, a solvent of isobutane and a temperature of about 15 F. are used. Boron trifluoride is the catalyst. The operations are similar to those described for high polymer, except for the final processing steps. The product, a liquid of high viscosity and tackiness, is taken directly from the flash drum.

YIELDS: Over-all yield of polymer, based on purified isobutylene, is 95-98 percent.

COMMERCIAL INSTALLATIONS: Indoil Chemical Company, Whiting, Ind.; Oronite Chemical Company, Richmond, Calif.; Enjay Company, Bayway, N. J.

Polyester Resin

NAUGATUCK CHEMICAL

APPLICATION: The process, a simple condensation reaction, is used to combine selected acids and glycols to form an unsaturated polymeric alkyd which is subsequently blended with an unsaturated crosslinking monomer to yield a fluid, curable resin.

CHARGE:

Alkyd Components—

Dibasic acids, such as maleic or phthalic anhydrides

Polyhydric alcohols, such as diethylene or propylene glycols

Crosslinking Monomers—

Styrene or allyl esters are typical examples.

PRODUCT: The product is a thermosetting plastic of the type usually, but inexactly, termed a "polyester." It is a resin comprised of an unsaturated alkyd dissolved in about 30 percent of an unsaturated crosslinking monomer.

DESCRIPTION: A typical reaction which might be used to produce a general purpose polyester resin (diethylene maleate) is outlined.

Alkyd Preparation—For a 300-gallon batch, 1728 pounds of diethylene glycol are charged to a glass-lined reactor equipped with marine type propeller agitators. Air is eliminated from the vessel free space by a blanket of inert gas such as a nitrogen-carbon dioxide mixture. The glycol is agitated while being heated to 80 C. after which 1500 pounds of maleic anhydride and 120 grams of hydroquinone (stabilizer) are added. Agitation is resumed after the maleic anhydride is melted and the temperature is raised to 200 C.

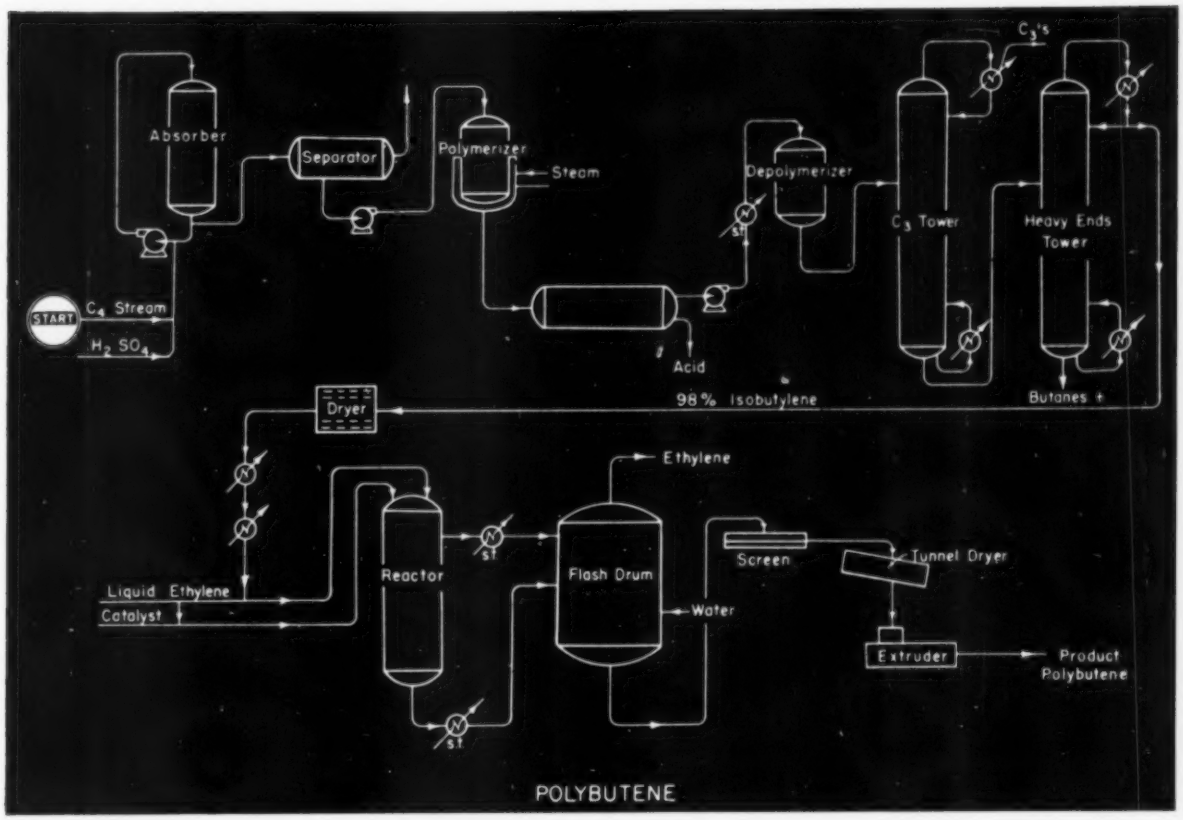
Water of esterification is removed as vapor, which is scrubbed to eliminate noxious maleic odors. Because of the speed with which water is removed, there is danger of foaming; therefore, the reactor is loaded to only 80 percent of its volume. The progress of esterification is measured by checking the acid number of the alkyd. The total heating period is approximately six hours, after which the finished alkyd is drained from the reactor to the blender for the addition of styrene.

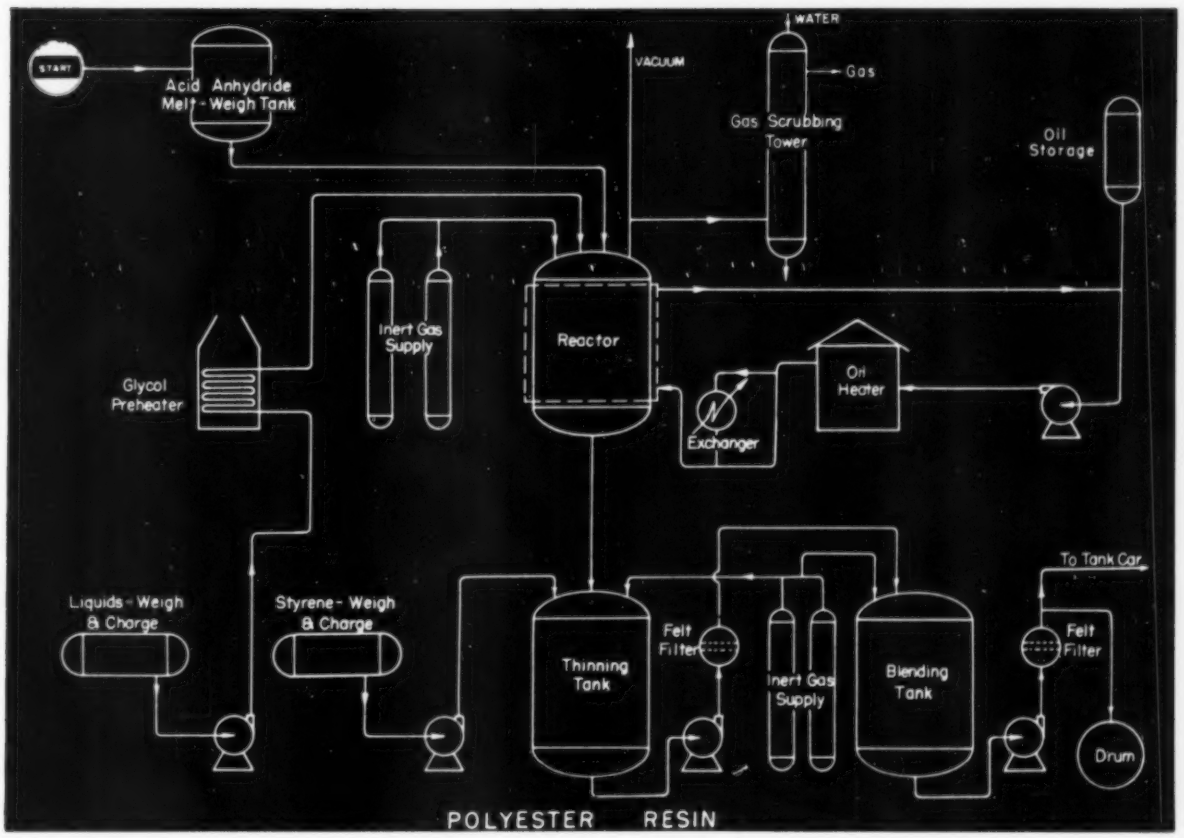
Monomer Blending—For a 300-gallon batch, a 700-gallon stainless steel-clad vessel, equipped with a marine-type agitator and an inert gas purge, is used as a blender. The alkyd is dropped from the reactor to this blender and cooled to 100 C., at which point an additional 180 grams of hydroquinone are added. The batch is then cooled further to 70 C. Styrene (1244 pounds) is pumped through a felt filter into the agitated contents of the blender at a point just below the alkyd liquid level. Complete mixing is assured by 2 to 3 hours of further agitation and cooling.

Finishing—To maintain consistent quality for the customer, the single reaction batches are given rigid control tests and sent to larger vessels where the individual batches are blended into uniform lots. The final blend is then pumped through a felt filter into 55-gallon drums and is ready for shipment to the fabricator.

YIELD: The yield of polyester resin is about 4120 pounds, or 92 percent of the material charged.

COMMERCIAL INSTALLATIONS: Approximately 16 manufacturers are engaged in the production of the basic polyester resins. Existing national capacity is estimated at 30 million pounds.


Absorber
Separator
Polymerizer
Steam
Depolymerizer
C_3's
C_3 Tower
Heavy Ends Tower
START
C_4 Stream
H_2SO_4
Acid
98% Isobutylene
Butanes +
Dryer
Ethylene
Reactor
Flash Drum
Screen
Tunnel Dryer
Liquid Ethylene
Catalyst
Water
Extruder
Product Polybutene
POLYBUTENE


START
Acid Anhydride Melt - Weigh Tank
WATER
VACUUM
Gas
Gas Scrubbing Tower
Oil Storage
Inert Gas Supply
Reactor
Glycol Preheater
Oil Heater
Exchanger
To Tank Car
Liquids - Weigh & Charge
Styrene - Weigh & Charge
Thinning Tank
Felt Filter
Inert Gas Supply
Blending Tank
Felt Filter
Drum
POLYESTER RESIN

Polystyrene

APPLICATION: The batchwise mass polymerization method for manufacturing polystyrene.

CHARGE: Styrene monomer, 99.6+ percent purity.

PRODUCT: Solid polystyrene.

DESCRIPTION: Styrene is polymerized commercially by several different techniques on both batch and continuous bases. The technique to be described here is mass (i.e., without extraneous materials other than catalysts) polymerization on a batchwise basis. This technique accounts for a very significant portion of the polystyrene produced in this country.

Monomer meeting plastics-grade specifications may require a caustic wash at the polymer plant to remove any *tert*-butylcatechol polymerization inhibitor present. The monomer is then pumped to the polymerization kettle.

The polymerization reaction requires heat for initiation. Once under way, the reaction gives off a considerable quantity of heat, and means must be provided for its removal. The kettle is, therefore, provided with coils through which either steam or cooling water may be passed. Agitation is provided by a mechanical stirrer, and a reflux condenser recovers vaporized monomer. A small amount of benzoylperoxide catalyst is added to the kettle contents. A polymerization temperature of about 225 F. is maintained. Pressure is atmospheric.

It is not feasible to carry the polymerization past 60-70 percent completion, since the reaction mass becomes so viscous that heat transfer is seriously impaired. After an operating time of two hours or so, the kettle contents are then discharged to a battery of small moulds so constructed that the contents are no more than one inch from the heat transfer surface.

The polymerization is completed in these moulds at a temperature of 320 F., steam-heating being necessary toward the end of the reaction. Finally, cooling water is turned into the mould jacket and the solid polymer is cooled to ambient temperature.

The blocks of polymer are removed from the moulds and dumped in a hopper feeding a crushing mill. The granular discharge from the mill is then conveyed to a storage bin from which feed to the extruding machines is taken.

The polymer is re-melted at the extruder and dye, if required, is added. The molten polymer is extruded, solidified in air or under water, and cut to the desired length.

YIELDS: Yields vary with the batch, some of which are completely off-grade. In general, yields are better than 95 percent.

COMMERCIAL INSTALLATIONS: Polystyrene is manufactured in the following installations: The Dow Chemical Company, Midland, Mich., Allyn's Point, Conn., Torrance, Calif.; Monsanto Chemical Company, Springfield, Mass., Port Plastics, Ohio, Long Beach, Calif.; Koppers Company, Kobuta, Pa.; Bakelite Company, Bound Brook, N. J., Los Angeles.

Polyvinyl Chloride

NAUGATUCK CHEMICAL

APPLICATION: This process is for the polymerization of vinyl chloride monomer to vinyl chloride resin.

CHARGE: The charge is high-purity water and vinyl chloride monomer.

PRODUCT: Vinyl chloride resins.

DESCRIPTION: Water is treated to remove all impurities, including carbon dioxide and oxygen. It is then preheated to reaction temperature before being charged to the polymerizers.

The pure vinyl chloride monomer and water are metered into glass-lined polymerizers where the mixture is vigorously agitated. The temperature in the vessel is then increased to between 110 and 130 F. depending on the exact formulation desired.

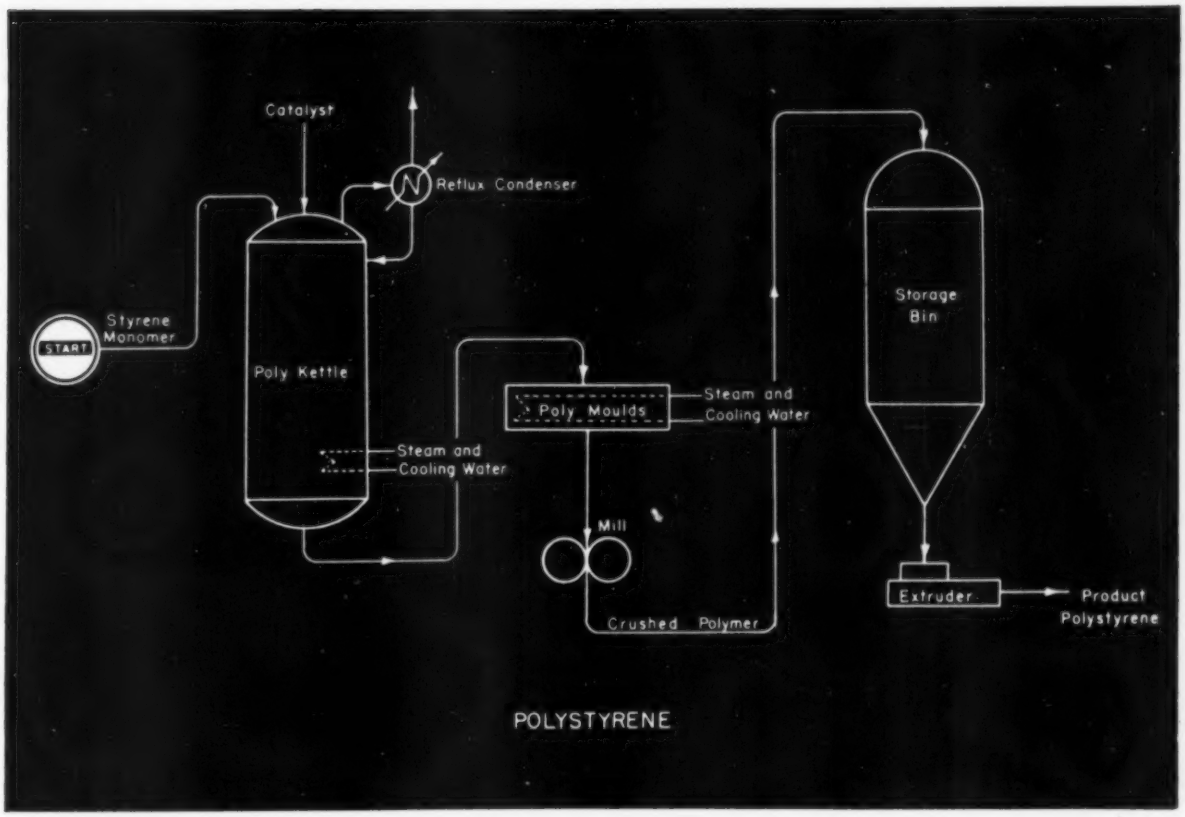
Catalysts and control agents are then added. The catalyst used may be hydrogen peroxide, water-soluble persulfates, or one of several organic peroxides. The control agents are wetting or suspending agents which control particle size.

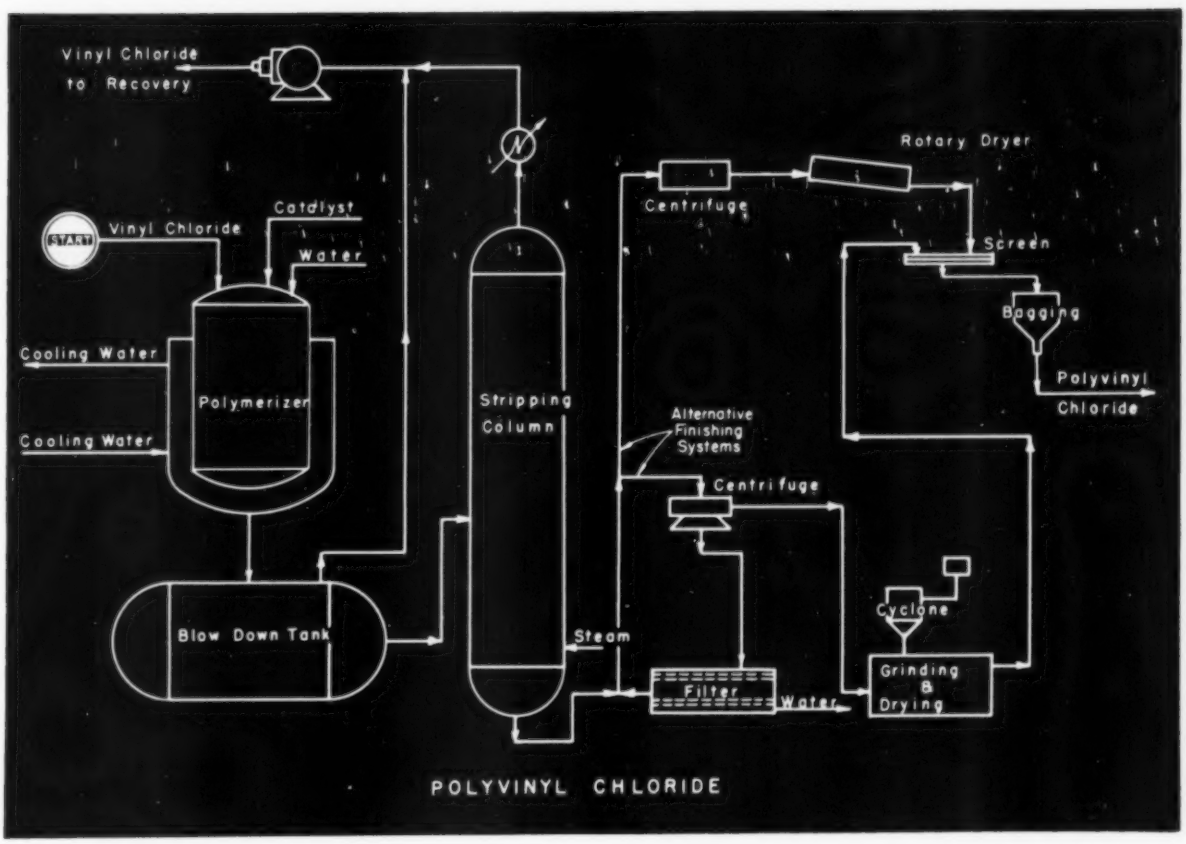
The polymerization reaction is exothermic, and the temperature must be controlled to within ± 0.05 F. to assure a uniform product. From the polymerizers the reaction mass goes to blowdown tanks where the vinyl chloride monomer is flashed off to compressor suction. After compression, the vinyl chloride is separated from any entrained water and sent to storage. It is then sent through a purification system before being returned to the process as charge stock.

The water-polymer suspension is fed to centrifuges, where the moisture content is reduced to about 20 to 25 percent. Two types of centrifuges, bottom discharge basket type and continuous, are used. The partially dried polymer is then dried in one of two types of dryers. One type dryer is a continuous flash type in which the material is also ground. The other is a continuous rotary dryer where heated air is passed countercurrent to the flow of polymer. Both dryers use air heated to about 140 to 150 F.

Any iron particles that might get into the resin are removed by magnetic separators on the conveyor lines.

The resin is then sent to screening devices which remove any large particles before the material goes to the packaging step. The dried resin is blended in large storage bins. It then goes to the packaging step where it is weighed into 50 pound lots and put into paper bags. The bags of finished resin are then sent to storage.


Catalyst
Reflux Condenser
Styrene Monomer
START
Poly Kettle
Steam and Cooling Water
Poly Moulds
Steam and Cooling Water
Storage Bin
Mill
Crushed Polymer
Extruder
Product Polystyrene
POLYSTYRENE


Vinyl Chloride to Recovery
Rotary Dryer
Centrifuge
Catalyst
START
Vinyl Chloride
Water
Screen
Bagging
Polyvinyl Chloride
Cooling Water
Polymerizer
Stripping Column
Cooling Water
Alternative Finishing Systems
Centrifuge
Cyclone
Blow Down Tank
Steam
Filter
Water
Grinding & Drying
POLYVINYL CHLORIDE

Alkyl Aryl Sulfonates

APPLICATION: A process for the manufacture of alkyl aryl sulfonates (synthetic detergent).

CHARGE: Kerosine, close-cut highly acid-treated or solvent-refined fraction, 425-475 F. boiling range; 20 percent oleum (fuming sulfuric acid); chlorine gas, 99 percent purity; benzene, nitration-grade.

PRODUCT: Alkyl aryl sulfonates (averaging $NaSO_3(C_6H_4)C_{12}H_{25}$), 85 percent purity (dry basis). The remaining 15 percent is sodium sulfate.

DESCRIPTION: The major processing steps in the manufacture of alkyl aryl sulfonates are: chlorination of kerosine; alkylation of benzene with keryl chloride; sulfonation of keryl benzene; neutralization of keryl benzene sulfonate. If propylene tetramer is substituted for kerosine as the source of the alkyl group, the chlorination step may be eliminated. This will be clarified in the following material.

The kerosine used in this process must be carefully chosen for high paraffin content, a maximum of straight-chains, and an average of about 12 carbon atoms. Improperly-chosen kerosine can adversely affect the properties of the final product as a detergent and wetting agent.

An excess of kerosine is fed with chlorine continuously to the alkylator, the contents of which are maintained at about 140 F. The operating pressure is only a few pounds above atmospheric. The alkylator is a lead-lined, agitated vessel equipped with means for heat removal. Hydrogen chloride generated during the reaction passes through a reflux condenser to an acid recovery system. Chlorination conditions are maintained such that the effluent keryl chloride (chlorinated kerosine, a mixture of true chemical compounds) contains 19-21 weight percent chlorine.

The effluent from the chlorinator, containing keryl chloride and unreacted kerosine, is pumped to the alkylator. This is also an agitated vessel, and contains glass lining or other material suitable for withstanding the corrosive conditions. In the alkylation operation, aluminum chloride catalyst and an excess of benzene are fed continuously to the alkylator along with the keryl chloride. The catalyst may be added separately to a circulating stream of "complex." The alkylation temperature is 140-180 F.; pressure is slightly above atmospheric. Hydrogen chloride evolved from the reaction passes through a reflux condenser to the recovery system. For a 6:1 molar ratio benzene:keryl chloride, a keryl benzene yield of 80-85 percent of theory is obtained. Keryl benzene is a mixture sometimes known as "dodecyl benzene" and includes some 95 percent C_{11}-C_{13} alkylated benzenes.

An alternate process employs propylene tetramer, obtained from the controlled catalytic polymerization of propylene under conditions of high temperature and pressure. This tetramer is unsaturated and may be reacted directly with benzene, using aluminum chloride catalyst, in a fashion similar to that described above for keryl chloride. The use of tetramer not only eliminates the chlorination step but also allows close control over the length and character of the alkyl group.

The crude alkylate passes to a vessel where spent catalyst, tars, etc. are removed from the mixture of keryl benzene, benzene, kerosine, and heavy ends. This latter mixture is separated in a series of three fractionating columns. The first removes benzene overhead for recycle to the alkylator. The second removes kerosine overhead for recycle to the chlorinator. The third removes keryl benzene overhead, leaving a residue of high boilers. A combination of vacuum operation and high pressure steam-heated reboilers is required in the second and third columns.

Keryl benzene is sulfonated continuously by 20 percent oleum in a stainless steel, agitated vessel. Cooling coils are provided to remove the heat of reaction. Temperature is about 90 F.; pressure is atmospheric. Approximately equal volumes of acid and oil are used. The sulfonation yield is on the order of 95 percent. A measured amount of water is added to the sulfonator effluent to dilute the spent acid to about 80 percent. The sulfonates are substantially insoluble in acid of this strength; the mixture is thus separated by conventional means at 120-140 F. The lower phase of acid cannot be used again for sulfonation in this process.

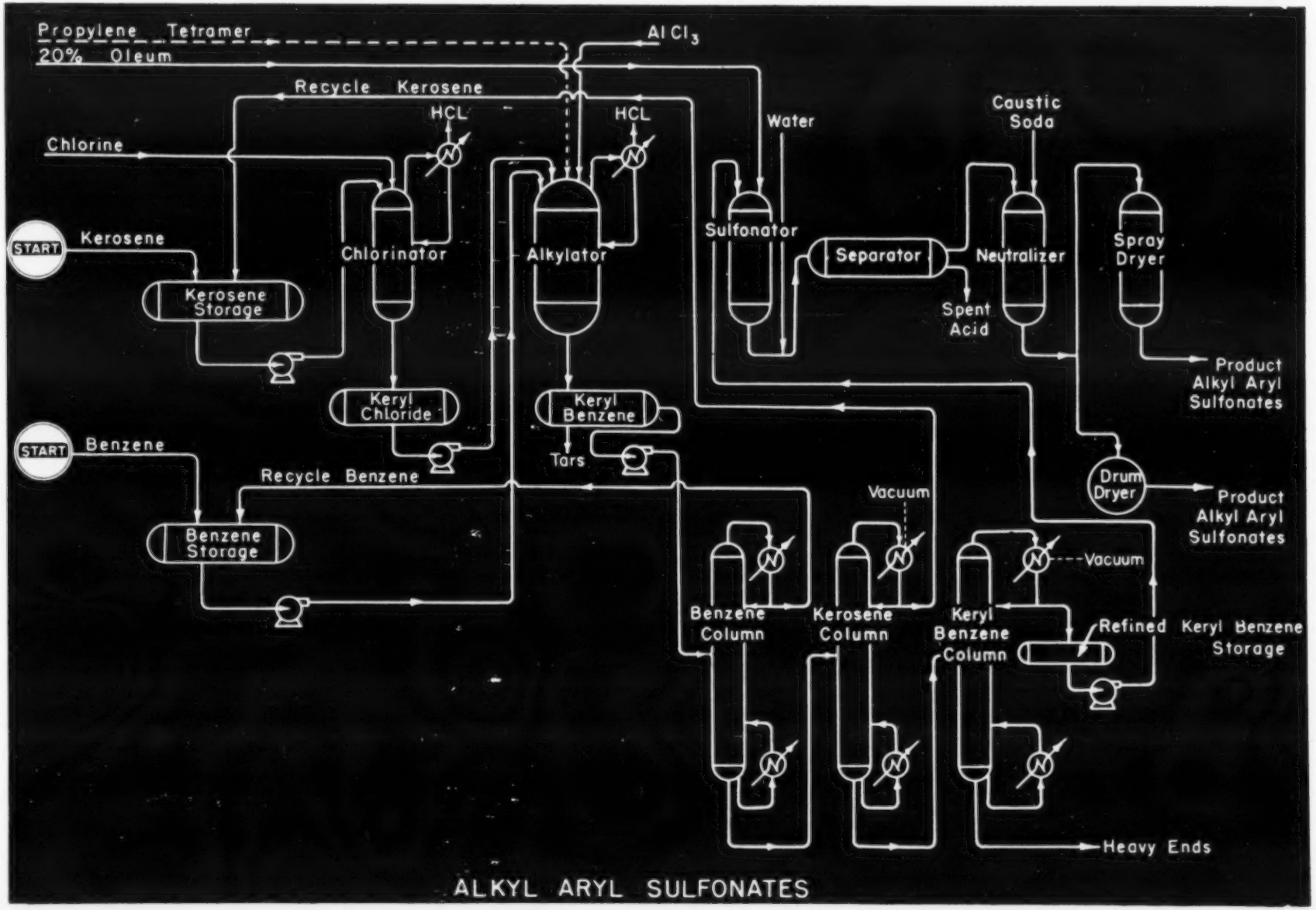
The sulfonates flow to the neutralizer where they are agitated with caustic soda. The strength of caustic is variable, depending on downstream conditions. Strengths of 20-50 percent are used. The neutralizer is a jacketed, stainless-steel vessel. The effluent has a pH of about 8 and a temperature of 105-120 F. It contains, on a dry basis, 85 percent alkyl aryl sulfonates, with the remainder sodium sulfate. The liquid is fed either to a spray dryer or to a drum dryer where the final product in powder or flake form is produced.

The 85 percent alkyl aryl sulfonates may be used directly as detergents, or compounded with inorganic builders such as sodium phosphates or polyphosphates. Thus, alkyl aryl sulfonates as finally marketed contain a varying percentage of active ingredient.

OPERATING CONDITIONS: Described in above text.

YIELDS: Over-all process yield, based on benzene, is 75-80 percent.

COMMERCIAL INSTALLATIONS: Oronite Chemical Company, Richmond, Calif.; General Dyestuff Company, Grasselli, N. J.; The Atlantic Refining Company, Philadelphia; Monsanto Chemical Company, E. St. Louis, Ill. and Nitro, W. Va.



ALKYL ARYL SULFONATES

Buna-S Rubber

NAUGATUCK CHEMICAL

APPLICATION: This process is applied to the manufacture of Buna-S type synthetic rubber.

CHARGE: The charge consists primarily of butadiene and styrene.

PRODUCT: The product is a high molecular weight copolymer of butadiene and styrene.

DESCRIPTION: In batch operation the butadiene and styrene are charged from weigh tanks or through charge meters in the approximate ratio of 70:30 to glass-lined, agitated, pressure vessels. Some plants are equipped for continuous polymerization which is accomplished by connecting in series a number of reactors (12 to 24) so that reactants flow from the top of one to the bottom of the next. A peroxide catalyst, a soap solution or emulsifier and a modifier are then added to the polymerization vessel.

The polymerization reaction occurs at either 112-117 F. or 41-43 F., depending on the type of rubber. When the polymerization reaction has proceeded to the desired conversion (60 to 72 percent, depending on the type of rubber or greater than 90 percent for some latices), the polymerization charge is shortstopped and then discharged to blowdown tanks. The shortstop material is usually an organic reducing agent which destroys the catalyst. The discharge from the last reactor of a continuous polymerization line enters a series of 10 displacement tubes whose combined capacities equal one reactor. This allows for the addition of shortstop at the desired point.

A monomer recovery unit usually consists of four butadiene flash tanks, three vacuum steam stripping towers and necessary compressing, condensing, pumping and storage equipment.

A portion of the recovered (unreacted) butadiene of 80 to 90 percent purity (1 to 2 percent styrene) is blended with fresh butadiene to arrive at a purity of 95.5 percent which is used to charge the reactors. About 10 percent of the butadiene charged can not be reblended and is returned to the butadiene plant for purification. Styrene accumulates to the extent of only 2 to 3 percent of the amount charged and is periodically shipped back to the styrene producers for repurification.

Stripped latex is stored in four blend tanks where the antioxidant is added to the stripped latex. The latex is ready for shipment or it can be further processed to solid or sheet rubber. In plants which are equipped to handle masterbatches, the additives, carbon black and/or oil, are added in emulsion form in this blend area just before coagulation. Subsequently, the latex is coagulated with salt and sulfuric acid which converts the latex to a slurry of rubber crumbs. These crumbs are dewatered on vibrating screens and a vacuum filter to about 40 percent moisture. The crumb is broken up in a hammer mill to permit a fine size particle to be charged to the 3-pass steam-heated continuous, circulating air dryer (air temperatures 175 F. to 195 F.) where the remaining water is removed. The dry crumbs are baled in 75 pound blocks.

YIELDS: Approximately 22 pounds of styrene and 70 pounds of butadiene are consumed for every 100 pounds of rubber produced. The actual hydrocarbon content of the finished rubber is, however, only about 91.5 percent.

COMMERCIAL INSTALLATIONS: Thirteen Buna-S copolymer plants located in the United States having an ultimate capacity of 860,000 long tons produced 650,000 pounds in 1952. One plant with a reported capacity of 65,000 long tons is operating in Canada.

Buna-N Rubber

NAUGATUCK CHEMICAL

APPLICATION: A process for manufacturing Buna-N type synthetic rubber.

CHARGE: The charge consists primarily of butadiene and acrylonitrile monomers.

PRODUCT: The product is a high molecular weight copolymer of butadiene and acrylonitrile.

DESCRIPTION: In the batch operation the butadiene and acrylonitrile are charged from weigh tanks or through charge meters in the approximate ratio of 70:30 to glass-lined, agitated, pressure vessels. A peroxide type catalyst, a fatty acid or rosin soap solution and a modifier are also added to the polymerization vessel. The most commonly used modifiers are alkyl mercaptans and xanthyl sulfides.

When the polymerization reaction has proceeded to the desired conversion (gel content or insoluble polymer increases rapidly at about 75 to 80 percent), the polymerization charge is shortstopped. The "shortstops" are usually organic reducing agents which destroy the remaining catalyst. The reaction material then goes to blowdown tanks.

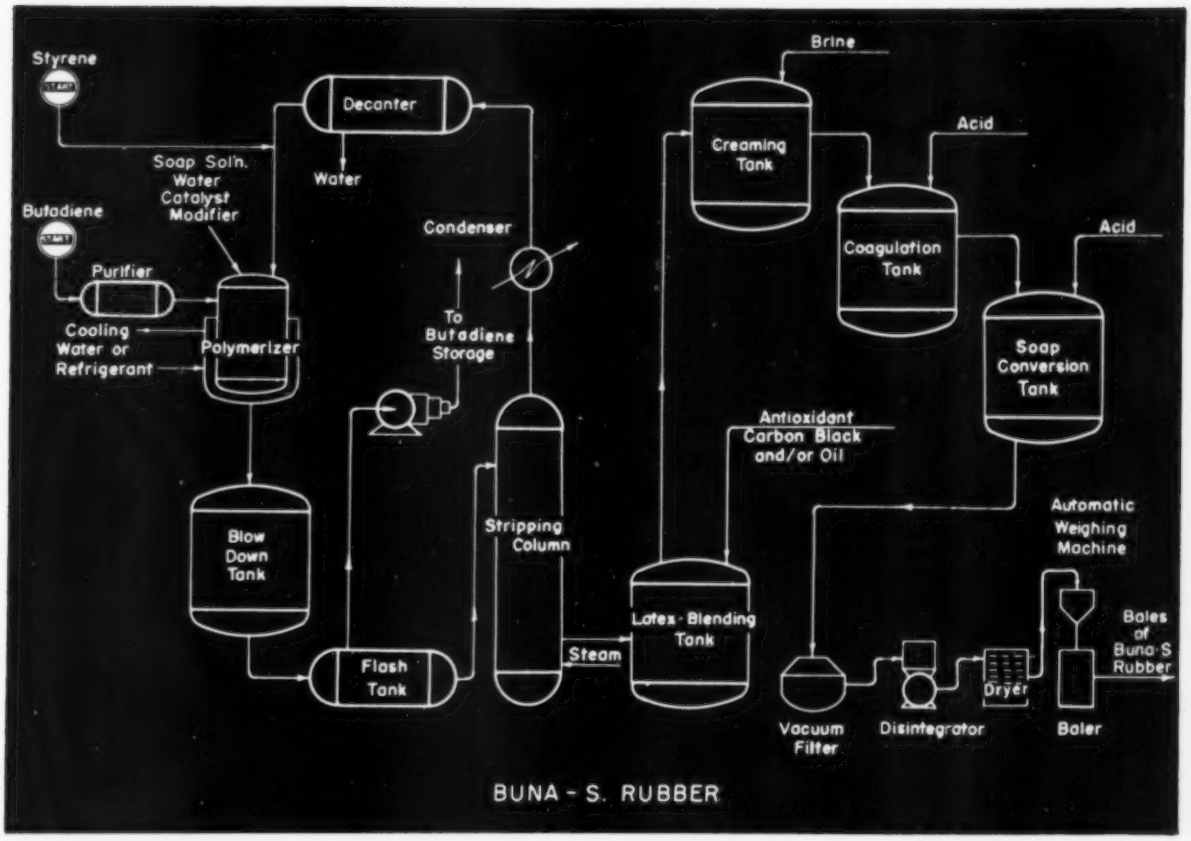
A monomer recovery unit usually consists of a butadiene flash tank and a steam stripping tower with necessary compressing, condensing, pumping and storage equipment.

A portion of the recovered (unreacted) butadiene of 80 to 90 percent purity is blended with fresh butadiene which is used to charge the reactors.

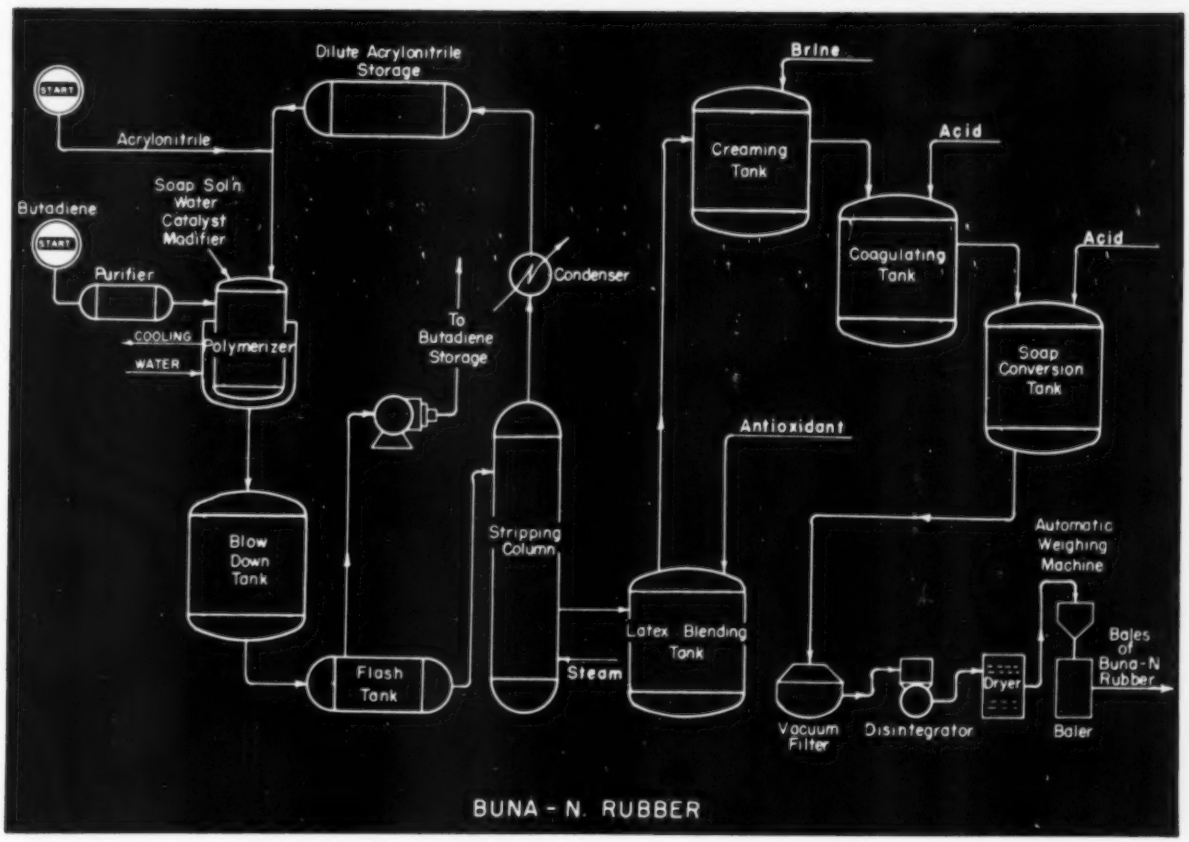
Recovered acrylonitrile in water solution from the steam stripping tower is recycled through dilute acrylonitrile storage tanks. This dilute material is analyzed and then used in subsequent polymerizer charges.

Stripped latex is stored in large blending tanks. The antioxidant is added to the stripped latex in these blend tanks to inhibit oxidation of the finished rubber. At this point the latex can be shipped or can be fed to the coagulation and dryer lines if the product is desired as sheet or crumb rubber. The latex is coagulated with salt and sulfuric acid which converts it to a slurry of rubber crumbs. These crumbs are dewatered on vibrating screens and by a vacuum filter. The crumb is then broken up in a hammer mill to permit a fine size particle to be charged to the steam-heated continuous, circulating air dryer (air temperature about 200 to 230 F.) where the remaining water is removed. The crumb, when baled in 75 pound blocks, is kept from sticking with a variety of dusting materials. The bales are packed in paper bags and the crumb is shipped in paper boxes.

COMMERCIAL INSTALLATIONS: Four Buna-N copolymer plants having a total reported capacity of 20,000 long tons per year are located in the United States. One small pant is producing Buna-N rubber in Canada. The total production of Buna-N rubbers in the United States in 1952 was 14,000 long tons.



BUNA - S. RUBBER



BUNA - N. RUBBER

Butyl Rubber

STANDARD OIL DEVELOPMENT COMPANY

APPLICATION: This process is applied to the manufacture of butyl rubber.

CHARGE: The charge consists of redistilled isobutylene and isoprene (or other conjugated diolefins).

PRODUCT: High purity butyl rubber in the form of blocks.

DESCRIPTION: Since butyl rubber is a copolymer of isobutylene and isoprene, it is manufactured by mixing these two raw materials in the proper proportions. The crude isobutylene is first fed to a tower where water is removed overhead. It is essential that the raw materials be water-free to prevent the formation of ice in equipment during the refrigeration step. After the water is removed, the isobutylene is fed to a distillation tower where the majority of the normal butylenes are removed out the bottom of the tower. The isobutylene and isoprene are then mixed with an inert diluent, methyl chloride, which serves as an aid in controlling the polymerization reaction. The blended feed is then cooled to a temperature of about —140 F. This cooled feed is fed continuously to individual reactors. In the reactors, the materials are agitated and are held at a temperature of —130 F. or lower by indirect cooling, using liquid ethylene as the refrigerant.

The reactors are also supplied with a chilled solution of catalyst which is mixed rapidly and thoroughly with the cold blended feed. Catalyst solution is prepared by dissolving aluminum chloride in methyl chloride of high purity. The butyl rubber is generated in the reactor in the form of fine particles suspended in the reaction medium.

The product emerges from the reactor as a slurry and passes to a flash drum containing hot, vigorously agitated water. On contact with the hot water, the unreacted components of the feed and the methyl chloride are flashed off to the recovery system, leaving in the flash drum a slurry of butyl rubber in water. The gases from the flash drum are compressed and then dried. Impurities are removed by fractionation. The isobutylene and isoprene which did not react is recycled back and mixed with the incoming, fresh feed. Solvent and catalyst are also returned to the reactor. Catalyst make-up is fed into this return stream.

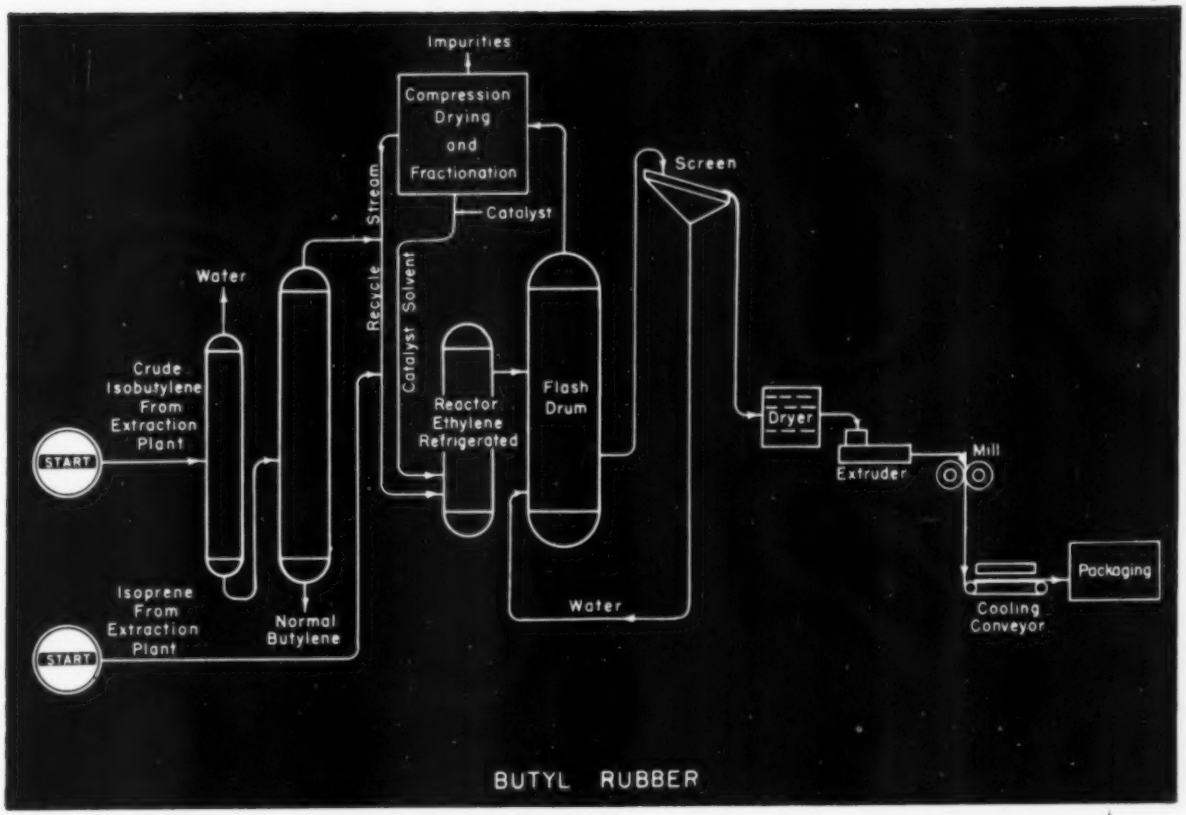
The water slurry formed in the flash drum is pumped to a finishing section. It first goes to rotary vacuum filters or vibrating screens where the bulk of the water is removed and a wet polymer crumb is isolated. Since the crumb must be more completely dried, the remaining water is removed by passing the crumb through a tunnel drier. The dry crumb is then fed to an extruder. Following this operation, the material is sent to a mill where a continuous strip of rubber is formed. This strip is passed through a cooling conveyor to a machine which cuts it into squares. These squares are then ready for packaging which is done by inserting them into cardboard containers. The butyl rubber is then ready for shipment.

Symbols Used

IN PETROCHEMICAL PROCESS HANDBOOK

KEY TO FLOW DIAGRAMS

For easy reading of the flow diagrams in this edition, the accompanying symbols were used to designate the process variables.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Screen
Stream
Catalyst
Water
Recycle
Catalyst Solvent
Crude Isobutylene From Extraction Plant
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Reactor Ethylene Refrigerated
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Dryer
Extruder
Mill
Packaging
Cooling Conveyor
Isoprene From Extraction Plant
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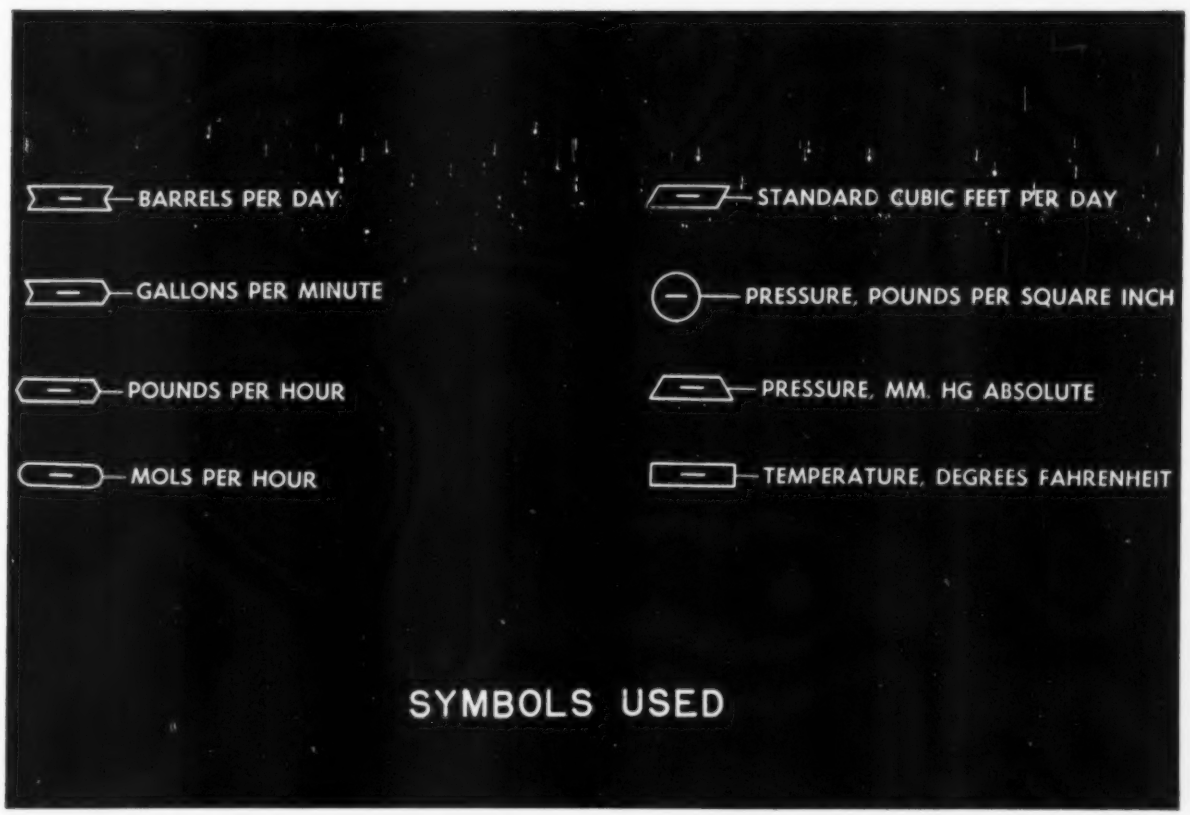
Normal Butylene
Water
BUTYL RUBBER


BARRELS PER DAY
STANDARD CUBIC FEET PER DAY
GALLONS PER MINUTE
PRESSURE, POUNDS PER SQUARE INCH
POUNDS PER HOUR
PRESSURE, MM. HG ABSOLUTE
MOLS PER HOUR
TEMPERATURE, DEGREES FAHRENHEIT
SYMBOLS USED

Meet Our **Authors . . .**

F. J. Soday

George Wash

C. F. Ruebensaal

R. B. Seymour

F. D. Snell

Soday Has Experience As Director of Research

Frank J. Soday, "Synthetic Fibers," page 114.

Frank Soday has been officially directing research and development since World War II. Presently director of research and development at The Chemstrand Corporation, he previously held similar positions at Lion Oil Company and Devoe & Raynolds Company, Inc.

During the war he was technical director for Copolymer Corporation, which operated the government synthetic rubber plant at Baton Rouge, La. Earlier he had been assistant laboratory manager for The United Gas Improvement Company; research group leader in petrochemicals for Monsanto Chemical Company; and group leader in the solvent refining of lubricating oils for The Pennsylvania Grade Crude Oil Association's Central Research Laboratories.

A native of Coaltown, Pa., Soday received a B.S. degree in chemical engineering at Grove City College in 1929; an M.S. degree and a Ph.D. degree from Ohio State University in 1931 and 1932, respectively. Holder of about 130 U.S. patents, he is a member of numerous technical societies, including ACS, AIChE, API and ASTM.

Wash Takes Part in Organized Education

George Wash, "The Status of Synthetic Ammonia in Fertilizer," page 112.

A graduate of the University of Texas, a pre-medical B.A. degree, an M.A. degree in chemistry, and a Ph.D. degree in organic chemistry, George Wash began his career in the oil industry in 1941 as a research chemist for Humble Oil & Refining Company. Prior to that time he had been a part-time instructor in chemistry at the University while doing graduate work.

Today Wash is assistant manager of the Fertilizer Sales division of Phillips Chemical Company, which he joined in January, 1947. He started at Phillips as an assistant to the manager of the Product Development division, advancing through several responsible positions to his present post April, 1950.

A native of Hall, Texas, he is a member and past president of the Bartlesville, Okla., board of education, a member of the board of directors of the Oklahoma State School Boards Association, and of several honorary societies. He is the author of numerous published technical articles.

An enthusiastic sponsor of youth activities in his community, Wash sets aside some of his spare time for golf and hunting.

Ruebensall Qualified to Review Synthetic Rubber

Clayton F. Ruebensall, "Synthetic Rubber," page 110.

Clayton Ruebensall, commercial development manager for the Naugatuck Chemical Division of United States Rubber Company, is a graduate of Case Institute of Technology. He was one of the organizers of the Chemical division of the Glenn L. Martin Company, Baltimore, and was, in part, responsible for the initial research, development and production of Marvinol polyvinyl chloride resins. He joined Naugatuck Chemical in 1949, when the company purchased the assets of Martin's Chemical division.

In 1945 and 1946 he was one of the technical consultants who visited Germany at the invitation of the U. S. government to study German methods of plastics production and research. He holds a number of U. S. and foreign patents in the fields of electrochemistry and plastics, and has written a series of articles related to synthetic resins and petrochemicals.

Hitchner a Veteran Of Pesticides Industry

Lea S. Hitchner, "Pesticides," page 117.

In just about every conversation or exchange of correspondence on the pesticides industry these days, one name has a habit of coming up. That name is Lea S. Hitchner, who, in his 30-year association with the pesticides industry, has literally grown up with it.

Another institution which he has grown up with is the National Agricultural Chemicals Association. His service with this 20-year-old organization: 20 years. He was instrumental in establishing the association and has served as president (1933-1940) and as executive secretary (1940 to present). At a recent meeting of NAC, association members presented Hitchner with a clock in recognition of his long service.

Prior to his duties with NAC, Hitchner was president of Lucas-Kiltone Company.

Seymour Compiles List Of Impressive "Doings"

Raymond B. Seymour, "Plastics and Synthetic Resins," page 116.

According to the two and three-eighths inches (in small type) devoted to him in the 1951 3rd Edition of *Chemical's Who's Who*, Raymond B. Seymour has been doing things since receiving a Ph.D. degree from State University of Iowa in 1937.

And he has! Seymour, who earlier received a B.S. degree (with honors) and an M.S. degree from the University of New Hampshire, has been an assistant in chemistry at the University of New Hampshire and at Iowa; a research chemist at Goodyear Tire & Rubber Company; chief chemist Atlas Mineral Products Company; research group leader at Monsanto Chemical Company; director of the industrial research institute at the University of Chattanooga; director of research at Johnson & Johnson; and technical director and general manager of Mineral Products Company. He joined Mineral Products in 1949 and is today executive vice president and technical director. Author of *National Paint Dictionary*, he has over 50 patents and publications in the fields of materials of chemical construction, plastics, synthetic rubber, textiles, and oil additives.

Snell Stays Busy And Then Some

Foster Dee Snell, "Synthetic Detergents," page 108.

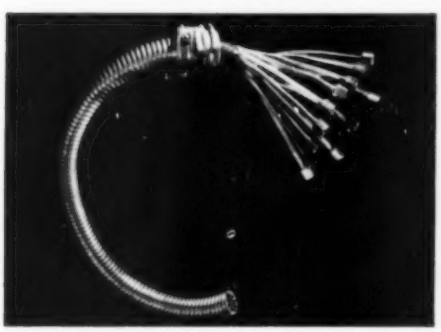
Being president of three companies would seem to be enough to keep even a human dynamo hopping all of his waking hours. But Foster Dee Snell, president of Foster D. Snell, Inc., Foster D. Snell Research, Inc., and Foster D. Snell Foundation, Inc., takes his presidential duties in stride and still manages to devote an enormous amount of effort to other activities. He is a member of numerous scientific organizations, in many of which he has held and holds office. Here are a few of them: American Oil Chemists Society (fourth vice president 1942-45); American Institute of Chemists (president 1946-48); Association of Consulting Chemists and

■ Continued on Page 283

For the new pneumatic instrumentation

Cabled Tube

The recent tremendous increase in the use of tube instead of wires for instrumentation and control purposes has led to an important new development—cabled tube. This is an armored group of long tubes twisted together to permit bending without distortion. An insulating tape is wrapped over the bundle of tubes to prevent electrolytic action. Then interlocking, flexible galvanized steel armor is applied, like BX. This protetts the tubes from injury during shipment, storage, installation, and in service. Standard fittings, boxes and cabinets can be used for junction boxes and terminations. To make it possible to readily identify each tube, one tube in each layer is colored; the position of each tube in each layer in relation to the coded tube

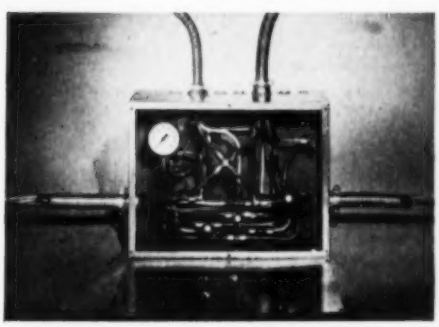


remains the same throughout the length of the cable.

The tubes usually are copper, but aluminum tubes can be used for special purposes. For unusually corrosive situations, a plastic outer sheath can be applied. As many as 19 tubes, ¼" OD, can be cabled, and supplied in lengths up to 1,000 ft.

Showing the construction of Crescent Armored Multitube, made by Crescent Insulated Wire and Cable Co., Trenton 5, N. J., which will supply further information on request.

Since the tubes carry not electricity but air, nitrogen, helium, or a fluid, they are especially attractive in potentially explosive locations, as in refineries and chemical plants. Utilities are also turning decisively to this new cable, while automatic process control (automation) is a rising application.



Revere, as a supplier of tube for this purpose, calls this cabled tube development to your attention as a matter of general and perhaps specific interest. See Revere for copper, aluminum and brass tube and pipe, electric welded steel tube, and lockseam tube. Call the nearest Sales Office.

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How to **Do It . . .**

Kidney Float Tester

Easily constructed device provides a fool-proof test for possible leaks in kidney floats.

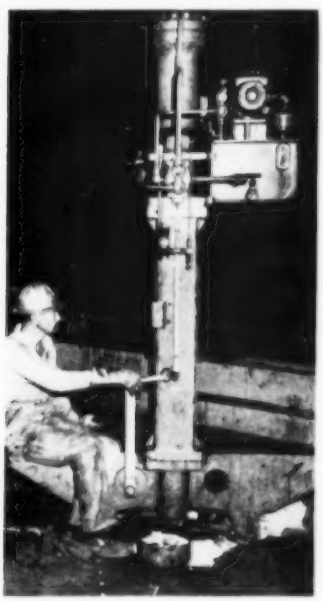
The operator in the above photograph is shown with a novel kidney float testing device. The device makes possible a fool-proof test for the air worthiness of kidney floats.

It is easily constructed by welding a flange and flange cover to a section of 20-inch pipe which has been sealed on one end. The vessel is supported with tripods made from 2-inch angle irons.

Here is how it works: The flange cover is removed and the vessel filled with water. The float to be tested is carefully weighed to the nearest half ounce. The float is then placed in the vessel, the flange cover replaced and secured with four bolts.

Then the valve shown under the operator's hand is opened to admit full line water pressure against the vessel. A test of about two minutes is usually sufficient. The cover is then removed and the kidney float again weighed. If it has any holes in it, water will have entered and the weight increased.

Only with this type of device can the repairman have complete confidence that he has a trustworthy and reliable kidney float. The cost of construction of the device is relatively low, with the major item being the flange and cover.



Tube Straightener **Saves On Bent Furnace Tubes**

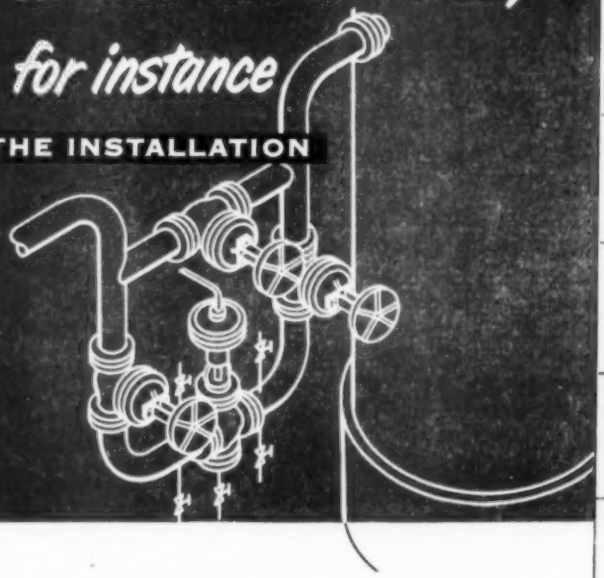
On many occasions, furnace tubes become bent or deflected because of the nature of the high temperature operation. In many refineries this tubing is scrapped and replaced with new tubes. In one large refinery, a device has been developed for removing the kinks and deflections from the tubing and restoring them for service. A very substantial savings in expensive alloy tubing is thereby accomplished.

The device is constructed from heavy gage, 8-inch I-beams, supported stanchions. The top edge of the I-beam is fitted with a series of six rollers. In addition, there are guides that fit along the bottom edge of the tube and other guides that fit the side of the tube.

The bent length of tubing is laid lengthwise on the supporting guides and the high load press is moved into position over the tube. Then, progressively, the press is moved down the transverse length of the tube, exerting force against the tube at points of deflection until the tube is absolutely straight and level.

You Can Measure this Valve's Quality on Hot Oil Service, for instance

THE INSTALLATION



In a leading lube oil plant on the Gulf Coast, using Crane Steel Valves on hot oil extraction lines from tower in Duo-Sol unit. Working pressure 100 psi at 850 degrees F.

VALVE SERVICE RATINGS

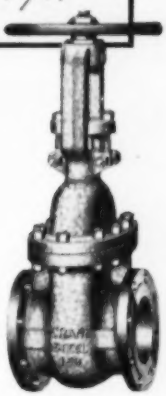
SUITABILITY:	Couldn't be better
FEATURES:	Exelloy trim
MAINTENANCE COST:	Routine service only
SERVICE LIFE:	No efficiency loss since 1951
OPERATING RESULTS:	Safe, dependable control
AVAILABILITY:	Catalog item — No. 47X

THE CASE HISTORY

Valves formerly used here were identical in design and appearance with their Crane replacements. But the similarity ended there. For they gave continual trouble in this round-the-clock process. Sticking discs made them extremely difficult to operate. They failed to hold tight on closure. Their replacement became mandatory for efficient operation.

It's been a different story since Crane 47X steel gates were installed almost 2 years ago. No more sticking of discs . . . no leakage anywhere . . . and with only routine maintenance.

THE VALVE



Work horse of the petroleum industry—Crane 150-pound steel gates—with exceptional performance assured by Crane quality design . . . Crane metallurgy . . . and the high adaptability of Crane Exelloy trim for oil and oil vapor services. Sizes 2 to 24 in.; screwed, flanged, welding ends. See your Crane Catalog or Crane Representative.

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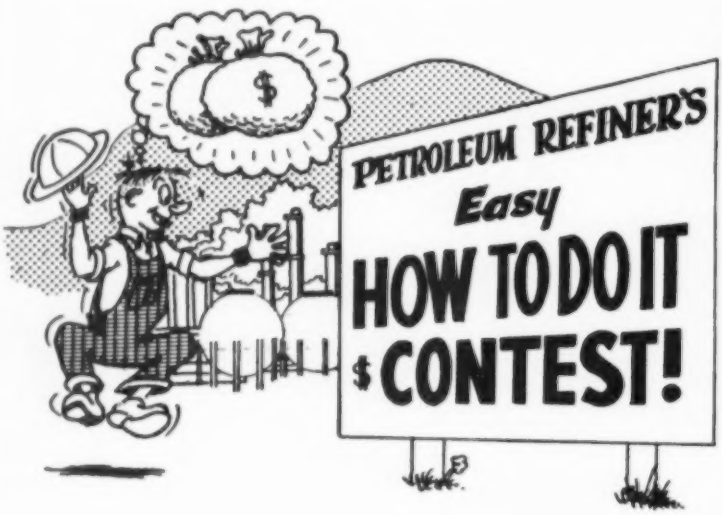


. . . Is Heading Down the Stretch ! ! !

In just a little over 30 days the winners of PETROLEUM REFINER'S How to Do It Contest are going to pocket $175. But the winners have not been determined yet! There's still time to get your entry in and get a shot at that prize money.

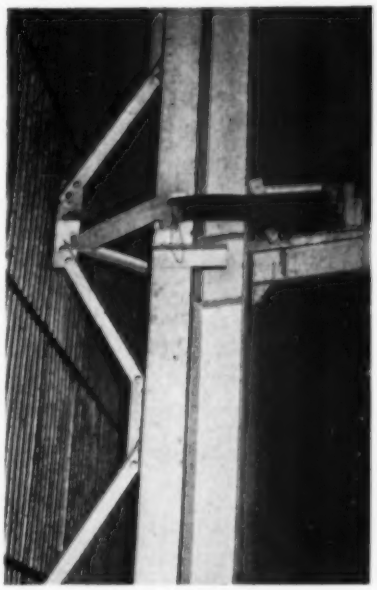
Entering is as easy as one, two, three:

1. Jot down your How to Do It idea. (The improvisions we are looking for can be found around almost any plant.)
2. Roughly sketch it, show how it works, or take a clear photograph of it.
3. Send it to us with your name and address.

Winners will be selected from those ideas printed, but all entries accepted—whether printed or not—win $10. The best idea wins $100; second place gets $50, and third place $25.

Don't worry about how good they are; send them in anyway. The gadget you think is nothing unusual might just be the idea that wins top money. You can't lose anything but a little time . . . and you *can* win.

Send all entries to Editor, PETROLEUM REFINER, P. O. Box 2608, Houston, Texas. Remember, there's just a little time left so get your entries in right away!



Unusual Brake **Controls Jib Crane From Ground**

The above photograph shows an unusual design for a brake to aid in the control of a jib crane.

The brake is constructed of a semi-circular strip of ⅛-inch metal serving as the track. Note the two small springs attached to the right-hand edge of the circular track. These springs maintain constant tension against the track. They are controlled with a pull cord which reaches to the ground level of the shop building. The brake assembly is rigidly fixed to the crane boom and to the building's structural supports.

The brake makes it possible to stop the crane in any desired position, lock it, and unlock it as necessary, with all operations conducted from the ground level. The construction cost is small, amounting to less than $25 for materials and labor.

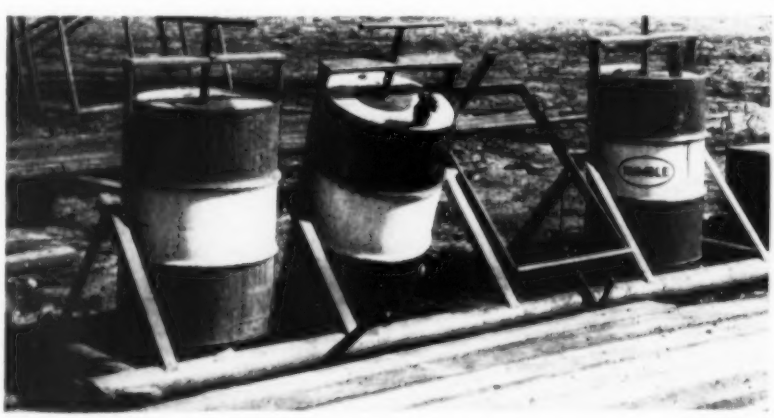
Fuel Oil Drum Rack **Enables Safe Handling**

Steel disks on a jack screw mounted on a rigid frame can eliminate the hazard of handling oil and fuel.

Arrange the racks so that the fuel bibb is aloft while the fuel is not in use, making leakage impossible. The rack and frame shown here can be made from scrap material.

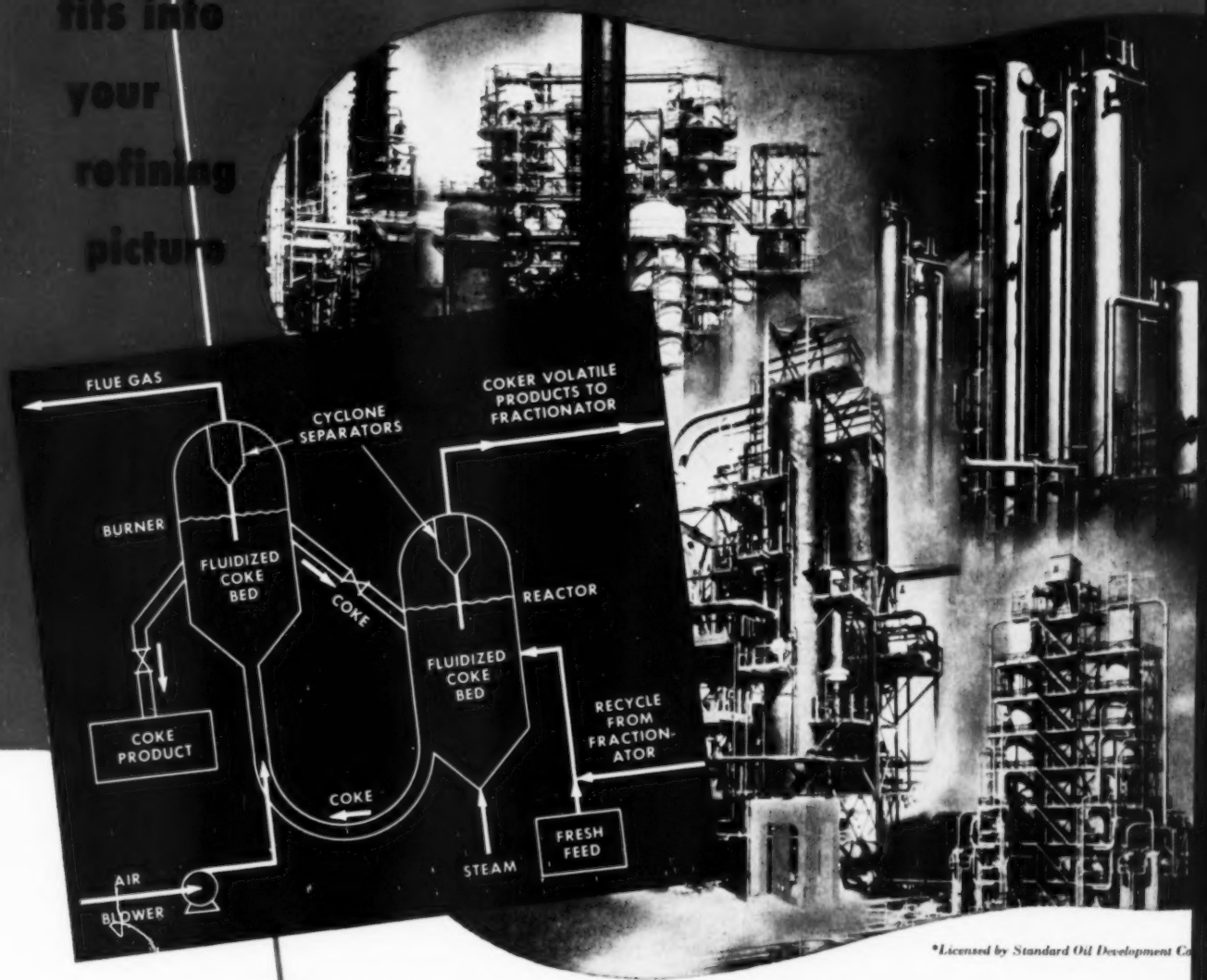
The steel one-inch stock strap and rectangular frame which encompass the drum are heavy enough to take the force of the jack screw. The jack screw itself is a large diameter stud bolt which is threaded through the steel bar at the top or through a companion hex nut welded to the underside of the bar.

The metal disk is made of light gage steel and is welded to the base of the jack screw. The pivots for the drums are made of 1½-inch steel rod welded to the vertex of the frame. They are slipped inside short two-inch nipples that are in turn welded to the angle iron supports. The foundation skid is made of four-inch pipe.



FLUID COKING*

Here's how fits into your refining picture



*Licensed by Standard Oil Development Co.

FLUID COKING makes profitable operations of processing low gravity crudes or residual stocks from other operations. In the preparation of catalytic cracking charge it results in a higher ultimate yield of gasoline. This new process permits charging a wide variety of feed stocks. It results in more liquid, less coke and virtually eliminates liquid residuum.

With its economical, continuous operation and low plant investment Fluid Coking will fit *profitably* into *your* refining picture.

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Call on McKee for facts and figures on Fluid Coking units. Our broad experience on all types of refining facilities is at your disposal.

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What's **Happening** in the Industry...

33rd Annual API Meeting Features Presentations of Service Awards

Hundreds of leading representatives of the refining industry were expected to be on hand at the American Petroleum Institute's 33rd Annual Meeting in Chicago early this month. Features of the session were to include the presentation of awards for outstanding contributions to the industry and to the API.

Awarding of the API "Gold Medal for Distinguished Achievement," one of the nation's highest industrial awards, was set for a general session Wednesday morning, November 11. Recipient of the 1953 achievement award is Otto D. Donnell, retired president of The Ohio Oil Company, and one of the founders of the API.

Various group sessions during the four-day program were to witness presentation of certificates of appreciation to oil men in recognition of their outstanding service to the oil industry.

In being selected to receive the API Gold Medal for 1953, Donnell was added to a list of prominent individuals. Previous recipients were Lieutenant-General Ernest O. Thompson of the Texas Railroad Commission, in 1951; Walter C. Teagle, former president and board chairman of Standard Oil Company (New Jersey), in 1950; J. Howard Pew, director and former president of Sun Oil Company, in 1949; Charles F. Kettering, director and consultant for General Motors Research Laboratories, in 1948; William M. Burton, former president of Standard Oil Company (Indiana), in 1947; and Henry Ford, founder of Ford Motor Company, in 1946. There was no presentation in 1952.

Otto D. Donnell

Donnell a Veteran

Donnell began his career as a mechanical engineer with The Ohio Oil Company in 1906. After getting wide experience in various branches of field work, he was elected in 1910 to Ohio's board of directors. He became a vice president in 1913, succeeded his father as president in 1927, and was, in turn, succeeded by his oldest son, James C. Donnell III, in May, 1948. Now 70, Donnell is a charter member of the API and has served it continuously since its inception. Through the years he has held several responsible posts, and, in 1950, the Division of Production honored him with the API "Certificate of Appreciation."

Among those scheduled to have received certificates of appreciation this year are many well known industry people.

At the Fundamental Research group session, Robert E. Wilson, chairman, Research Committee of the board of directors, was scheduled to present certificates to Stuart E. Buckley, Humble Oil & Refining Company; Ben B. Cox, Gulf Research & Development Company; L. M. Henderson, The Pure Oil Company; and Wayne E. Kuhn, The Texas Company.

At the Public Relations group session, Stanton K. Smith, chairman of the Oil Industry Information Committee, and of Smith Oil and Refining Company, was to have awarded certificates of appreciation to these OIIC members: William Finnegan, Jr., Humble Oil & Refining Company; W. Chalmers Burns, Hartol Petroleum Corporation; Emmett Howard, American Oil Company; W. J. Loufman, Fleet Wing Corporation; Frank V. Martinek, Standard Oil Company (Indiana); and A. T. Smith, Continental Oil Company.

At the Financial and Accounting group session, Donald P. Jones, Sun Oil Company, was scheduled to present a certificate to L. E. Hanson, Socony-Vacuum Oil Company.

At the Statistical Advisary Committee session, Henry Schwall, Shell Oil Company, was slated to award a certificate of appreciation to John W. Boatwright, Standard Oil Company (Indiana).

At the American Petroleum Industries Committee, the API certificate of appreciation was slated to go to Cyrus S. Gentry, president, Wolverine Pipe Line Company.

Continuous Contact Coking

Two papers scheduled to be presented at the Division of Refining general session were expected to draw wide interest. The two are: "Fluid Coking of Residual," by A. Voorhies, Jr., Esso Standard Oil Company, and H. Z. Martin, Standard Oil Development Company; and "The Lummus Continuous Contact Coking Process," by Valentine Makler, A. H. Schutte, and T. T. Whipple.

The Voorhies-Martin paper describes a new refining process which will help conserve U. S. petroleum resources by making more gasoline and home heating oil from crude oil. The novel process, called "fluid coking," provides oil refiners with a flexible and economical means of accomplishing this desired result. Under development for more than four years by the central research and engineering affiliate of Standard Oil Company (New Jersey), the new process is now being installed commercially. For the consuming public, fluid coking offers new sources of automotive and home fuels because the process converts the low value crude oil and crude fractions into the more needed products. The fluid coking process is the latest application of the "fluidized-solids" technique originated by Standard Oil Development Company.

The Mekler-Schutte-Whipple paper reports that continuous contact coking, a new process developed by The Lummus Company, increases the yield of light oils from crude oil by high-temperature cracking of heavy residua. The residua are converted into gasoline, jet-engine fuels, furnace oils, and intermediate distillates. The heavy residuum which lacks markets in many sections of the country is converted by contacting it with hot coke at temperatures higher than conventional refining methods. The process has the net effect of stretching each barrel of crude a little further.

Brown to Succeed Smith as National Chairman of OIIC

G. Stewart Brown, public relations manager of Standard Oil Company of California, has been elected national chairman of the Oil Industry Information Committee for 1954. He will succeed Stanton K. Smith, president of Smith Oil & Refining Company, Rockford, Ill., January 1. Brown was elected unanimously at a recent meeting of the committee.

Brown

Vice chairmen elected were: Richard Rollins, secretary, The Atlantic Refining Company; W. R. Huber, general manager of retail sales, Gulf Oil Corporation; Douglas Campbell, public relations director, The Pure Oil Company; and A. D. Eubank, division manager, Quaker State Oil & Refining Company.

John S. Coke, of API, was reelected secretary.

Also at the meeting, the committee scheduled one more meeting this year and four next year.

Two Members of Rubber Board Named by President Eisenhower

President Eisenhower has named two of the three members of the Synthetic Rubber Facilities Disposal Board authorized by Congress to negotiate the sale of 28 government owned plants. The group is expected to start to work almost immediately.

Appointed were Everett R. Cook, Memphis cotton broker, and Leslie R. Rounds, New York Federal Reserve Bank vice

What's **Happening** . . .

president. Cook reportedly will serve as chairman. White House did not elaborate on reasons for holding up appointment of the third member.

Shell Chemical Appoints Humphreys Vice President

Cecil W. Humphreys has been appointed vice president in charge of manufacturing for Shell Chemical Corporation. He had previously been general manager and manager of development for the company's Manufacturing department.

Humphreys

Joining Shell Chemical as a laboratory assistant at the Pittsburg, Calif., plant, he later worked as chief chemist at the company's Martinez, Calif., plant and assistant superintendent of the Dominguez plant. He moved to Houston in 1941 to act as manager of the chemical plant there. In 1946 he became manager of nation-wide operations in Shell Chemical's Manufacturing department.

Mines Bureau Forecaster Sees 4% Rise in 1954 Petroleum Need

An increase of 4 percent in total demand for petroleum products in 1954 is expected by a Bureau of Mines forecaster. He expects a 5 percent increase in domestic demand, including a 6 percent increase in gasoline demand. However, the total gasoline demand increase is estimated at only 5 percent, with exports slated to drop 20 million barrels from 1953.

If weather is "normal" in the first quarter of 1954, the demand for distillate will increase 8 or 9 percent because last winter was very mild, he said. He doesn't expect much gain in residual demand, with kerosine and other products also staying somewhat near 1953 levels.

His predictions, he emphasized, are preliminary. The official Bureau of Mines 1954 forecast will not be made until December.

In addition to its 1954 forecast, the Bureau of Mines is making a revised forecast for 1953. New estimates (in millions of barrels), with previous forecast figures in parentheses: total demand, 2,976 (2,824.5); motor fuel, 1,274 (1,191); residual, 603 (584); distillate, 543 (513.7); kerosine, 134 (132.5); all others, 422 (403.4).

Mines Bureau Reports Drop in World Refined Products Output

Total production of major refining products (exclusive of USSR and Eastern Europe) averaged 10,804,000 barrels a day in April, 1953, compared to 11,003,000 barrels a day in March, the Bureau of Mines has reported.

In barrels a day, production of motor fuel in April was 4,444,000, compared to 4,505,000 in March; kerosine, 672,000, 666,000 in March; distillate fuel oil, 2,228,000, 2,313,000 in March; residual

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No annunciator system ever offered as much in value as PANALARM "50".

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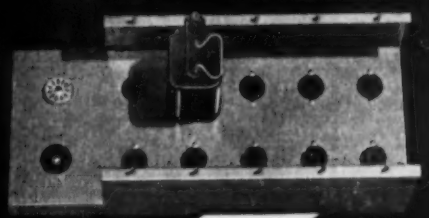
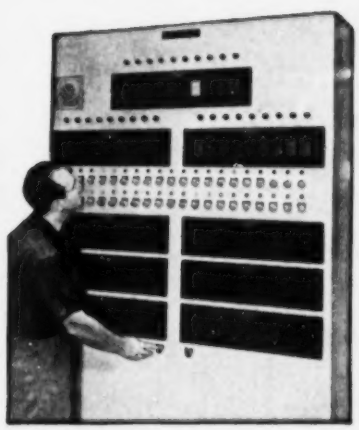
is interchangeable without re-wiring for all types of annunciator service: standard audio-visual; ringback; bullseyes or nameplates; trouble or running signals; lock-outs; or low drain operation.





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In hundreds of plants—serving for many years—Panalarm Annunciators have demonstrated outstanding performance. They have won confidence for the very critical part they play in plant operation and safety.

PANALARM PLUG-IN UNITS

. . . *heart of the system* . . . incorporate finest telephone-type relays and special contact arrangements . . . assure sequential operation. Hermetically sealed suitable for Class I, Div. 2 locations.

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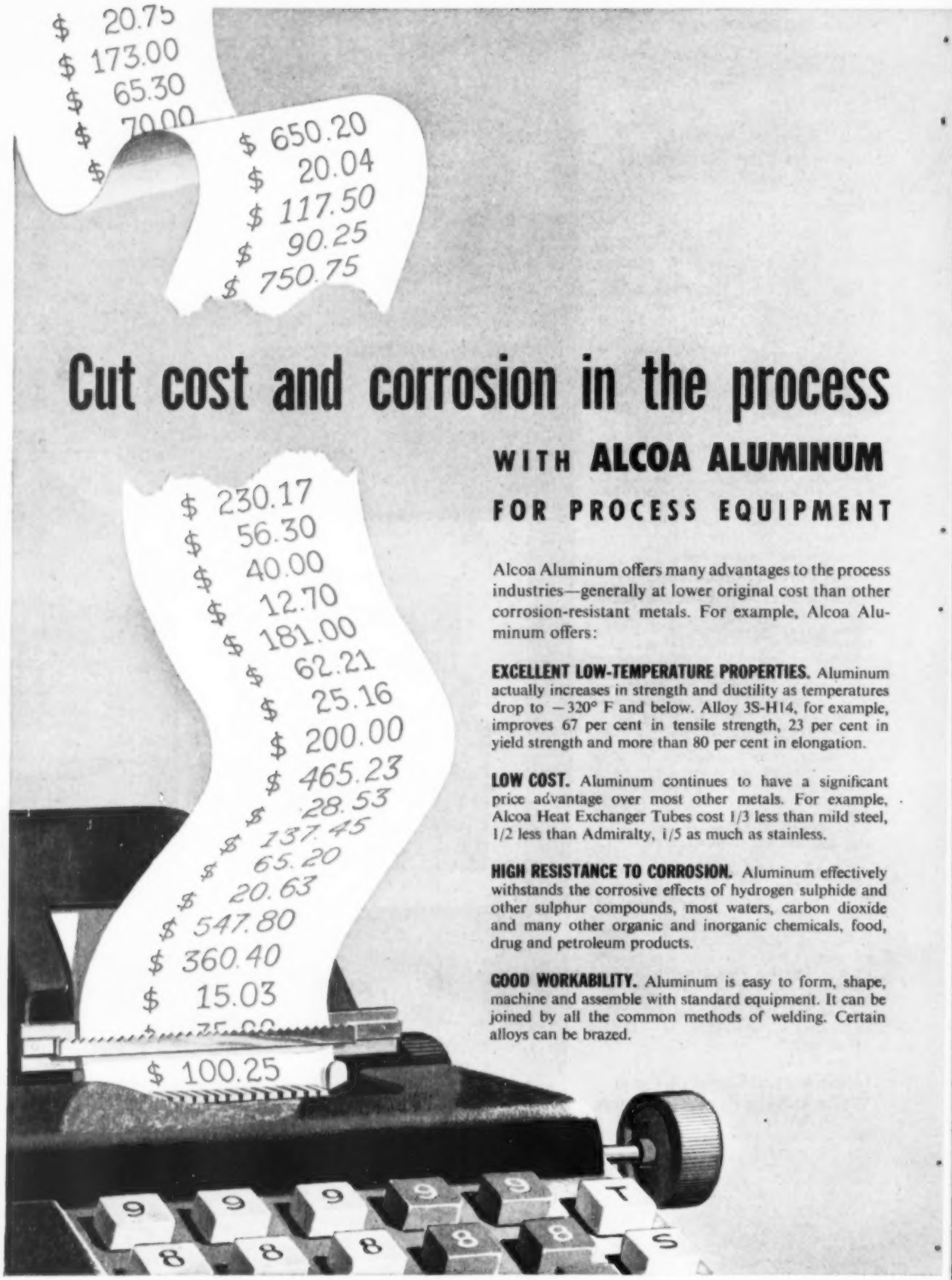

Cut cost and corrosion in the process

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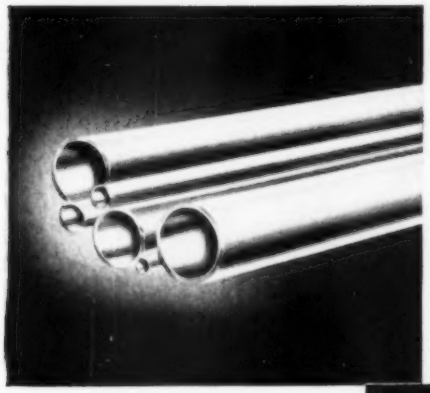
Alcoa Aluminum offers many advantages to the process industries—generally at lower original cost than other corrosion-resistant metals. For example, Alcoa Aluminum offers:

EXCELLENT LOW-TEMPERATURE PROPERTIES. Aluminum actually increases in strength and ductility as temperatures drop to −320° F and below. Alloy 3S-H14, for example, improves 67 per cent in tensile strength, 23 per cent in yield strength and more than 80 per cent in elongation.

LOW COST. Aluminum continues to have a significant price advantage over most other metals. For example, Alcoa Heat Exchanger Tubes cost 1/3 less than mild steel, 1/2 less than Admiralty, 1/5 as much as stainless.

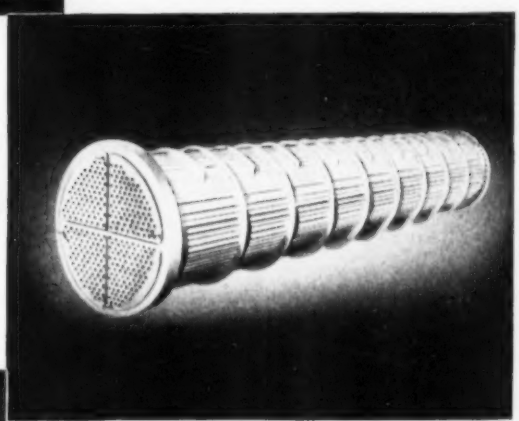
HIGH RESISTANCE TO CORROSION. Aluminum effectively withstands the corrosive effects of hydrogen sulphide and other sulphur compounds, most waters, carbon dioxide and many other organic and inorganic chemicals, food, drug and petroleum products.

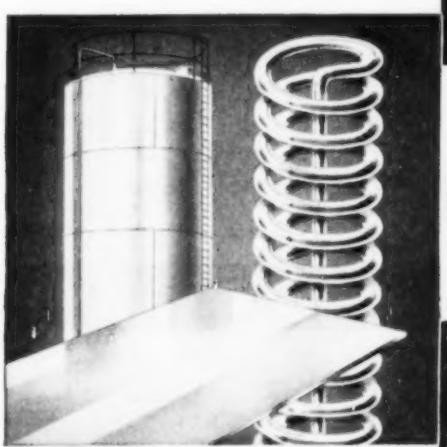
GOOD WORKABILITY. Aluminum is easy to form, shape, machine and assemble with standard equipment. It can be joined by all the common methods of welding. Certain alloys can be brazed.



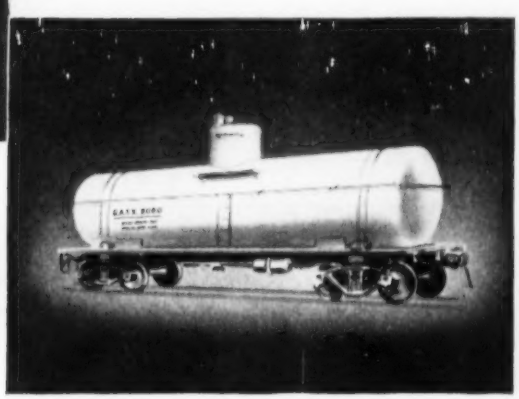
ALCOA ALUMINUM PIPE is the lowest cost corrosion-resistant metal pipe. It is not attacked by, nor does it contaminate or discolor, many chemicals. Does not cause sludge or gum in petroleum products. Friendly to most foods, beverages, oils. Alcoa Pipe is ideal for railings, scaffolds, storage racks and many other structural uses. Write for the booklet: "Alcoa Aluminum Pipe."

ALCOA ALUMINUM HEAT EXCHANGER TUBES offer *big* savings in original cost. For instance, an average-sized refinery can save $50,000 in first cost (figured on 20,000 tubes) over other metal tubes. Further savings in handling, shipping, cleaning—as well as excellent low temperature service and resistance to corrosion—make Alcoa Tubes the best buy, by far, for heat exchanger service. Write for the booklet: "Alcoa Aluminum Heat Exchanger Tubes."





ALCOA ALUMINUM SHEET AND PLATE, Forgings, Coiled Tube, Tread Plate and Storage Tanks offer exceptional cost-cutting advantages to the processing field. Write for the pamphlet: "Alcoa Aluminum in the Process Industries."



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insoluble in water . . .

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clean and pleasant to handle . . .

easy to cut with a knife . . .

won't break or crumble . . .

superior in thermal efficiency . . .

easy to finish . . .

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fuel oil, 3,273,000, 3,337,000 in March; and lubricating oil, 187,000, compared to 182,000 in March.

Sinclair Assigns Ischie to New Light Oil Operations Post

W. Vaughn Ischie, assistant to the refineries manager at Sinclair Refining Company's New York office, has been appointed assistant manager of Light Oil Operations. Ischie joined the Research department of Sinclair at East Chicago, Ind., in 1920.

Ischie

He was transferred to the Manufacturing department in 1929, later becoming operating superintendent of the East Chicago refinery, which position he held until February, 1952. At that time he was granted a year's leave of absence to accept the position of director of the Foreign Refining division of PAD. He was appointed assistant to the refineries manager upon his return from PAD.

IRAA Writes Letter Offering Cooperation With White House

M. H. Robineau, president of the Independent Refiners Association of America, has released a letter to Gabriel Hauge, administrative assistant to the president, in which is expressed IRAA's willingness "to cooperate to the fullest extent" in studying IRAA's proposals for handling imports.

"Last May," Robineau stated, "the IRAA recommended to the President a plan under which the Congress of the United States would declare as a national policy that imports might supplement but could not supplant domestic production of petroleum and petroleum products."

Robineau said that on June 16, an acknowledgment was received from Hauge, who, at the request of the President, assured IRAA that the problems set forth "will be carefully considered by the appropriate authorities and by the Commission studying the over-all foreign economic policy."

"It now seems appropriate to urge intensive study of the IRAA proposal," Robineau said. "I am very hopeful that this offer of cooperation will be received in the spirit in which it is made and that serious consideration can and will be given to the proposals first advanced by the Independent Refiners Association of America," he added.

Foster Reveals Sohio Plans To Enter Petrochemical Field

The Standard Oil Company (Ohio) may enter the petrochemical field in the not too distant future, C. T. Foster, Sohio president, said in a recent address. He revealed that his company had been studying the problem closely for some time and that "our plans are becoming more tangible." He said that the company expects that developments in its manufacturing process as well as those in the field of petrochemicals will present at some point an attractive oppor-

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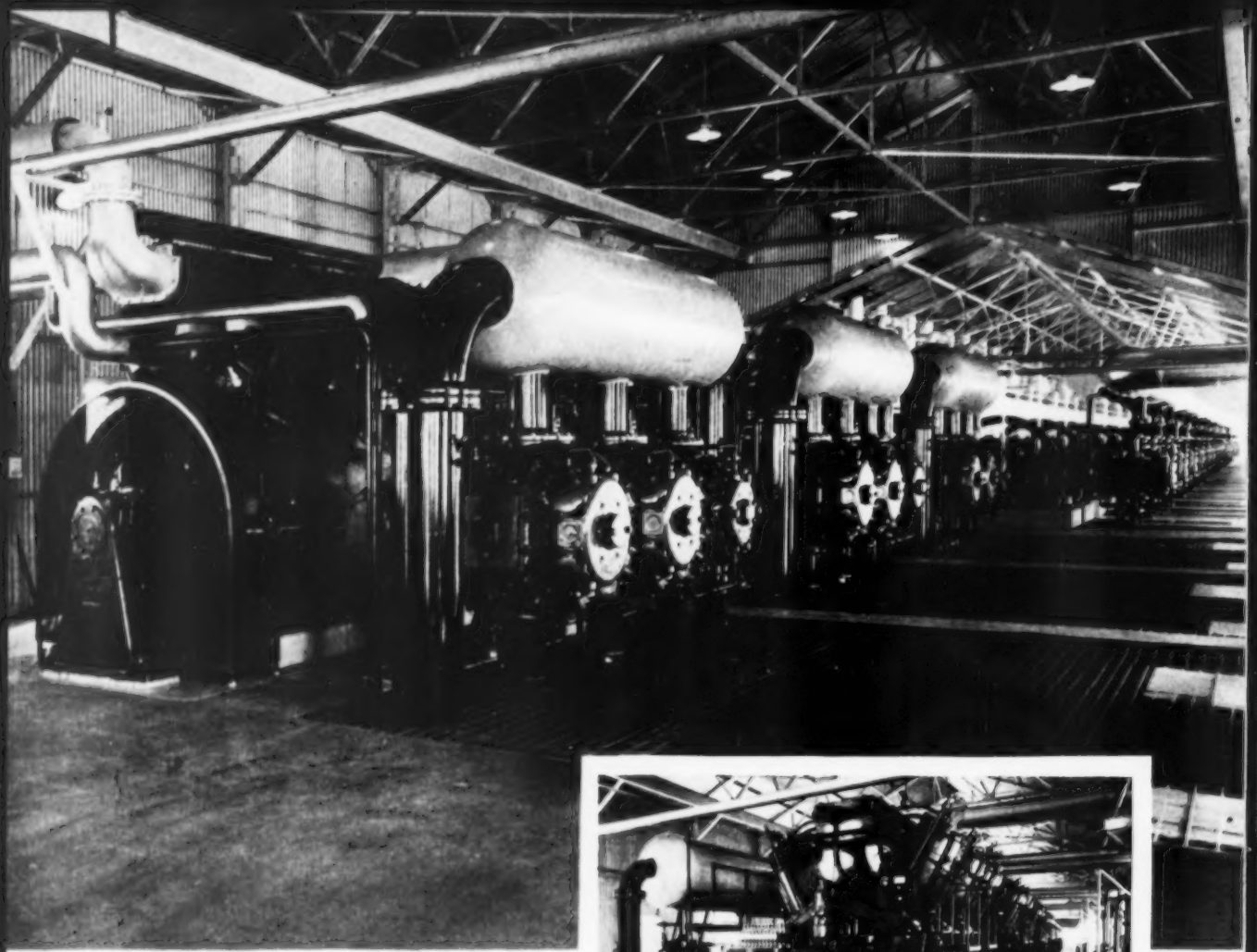

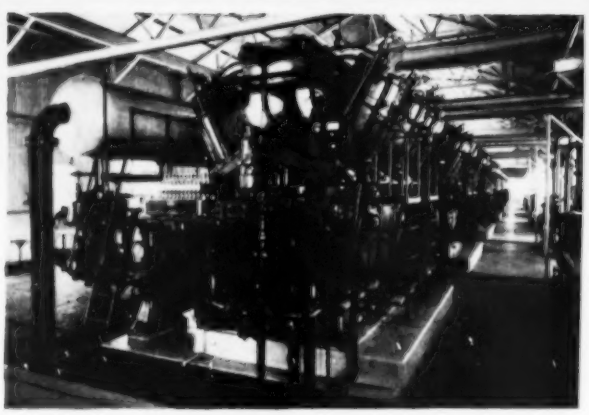

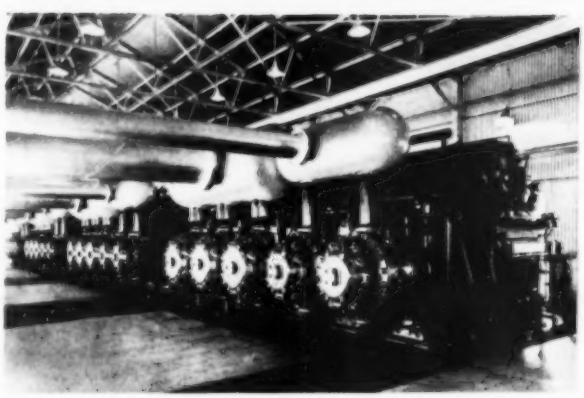

Above: Line-up of modern, compact 600 hp GMV-6's and old-type 200 hp C-B horizontals in Skelly Oil Company's Eunice gasoline plant. Old horizontals, originally installed in 1926 at Skelly's Seminole plant, were moved to present location in '49 . . . and have averaged about 98.9% running time.

Top Insert: This line-up of 7 GMV's includes the three 6-cylinder units shown in the large photo, plus 4 very recently added 1350 hp GMV-10's. Modern GMV's in the Eunice plant now total 7200 horsepower.

Bottom Insert: Close-up of the compressor cylinder side of the 4 recently added GMV-10 compressors. Note that each unit drives 5 cylinders — one for every crankthrow.

ANGLE

Compressors

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San Francisco, Cal. Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle, Wash.

Another Example of Efficient Power at Lower Cost

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A 27-YEAR LINE-UP OF COOPER-BESSEMER COMPRESSOR HORSEPOWER

THE compressor line-up in the big photo opposite includes modern GMV's and 27-year-old horizontals. Today both types, totaling over 10,000 horsepower, are working side by side in Skelly Oil Company's Plant #2 at Eunice, New Mexico.

The photo reveals a significant contrast in space requirements. The old horizontals, 19 of them extending to the vanishing point, produce 200 hp per unit. But the compact, new GMV's, actually occupying less space, are rated 600 hp — 3 times as much power per unit. And what's more, today's GMV's, unmatched in thermal efficiency, consume less than 7500 B.T.U. per horsepower hour!

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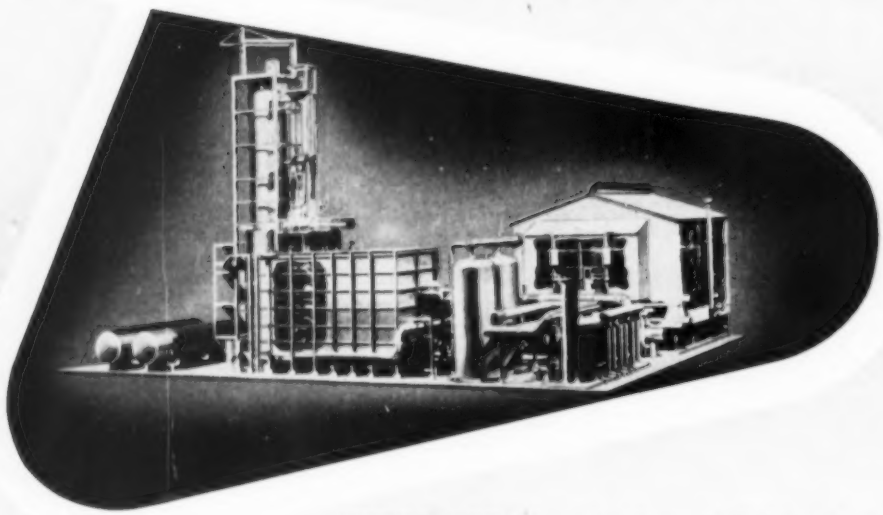

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What's **Happening** . . .

tunity for entry into the field. "This point," he said, "seems to be moving closer."

PAD Releases New Goals for Petroleum Industry Production

Details of an agreement reached by PAD and the Office of Defense Mobilization on petroleum expansion goals the government would like industry to attain by January 1, 1956 have been revealed by PAD.

Earlier PAD had recommended goals, but ODM had suggested slightly higher figures. The present goals are the results of a series of conferences.

Included in the goals are: refining capacity—400,000 barrels a day in 1954 and 250,000 barrels a day in 1955 to reach a total of 8,750,000 barrels a day by January 1, 1956 (ODM originally had asked PAD to raise the goal to 8,900,000 barrels a day but yielded finally to the PAD view); natural gas liquids procession capacity—construction of 200,000 barrels a day of net capacity in both 1954 and in 1955 to reach a total of 1,280,000 barrels a day.

Survey Shows Increase in Cities Getting Higher Octanes

Compared to the previous survey, the number of cities showing higher average octane ratings for both premium-grade and regular-grade gasolines has been increased by one, according to the October, 1953, motor gasoline survey issued by E. I. Du Pont de Nemours & Company, Inc. The October survey shows results of tests conducted on 720 fuels: 358 premium and 362 regular. Samples were purchased by Du Pont service representatives from retail outlets in 44 U. S. cities and 6 Canadian cities between September 29, 1953, and October 2, 1953.

The number of cities having premium octane ratings of 90 or above was 40 compared to 39 in July, 1953. Milwaukee had the highest premium octane rating with 94.0.

The number of cities having regular octane ratings of 85 or above was 19 compared to 18 in July. Cleveland and Pittsburgh had the highest octane rating in this classification with 87.6.

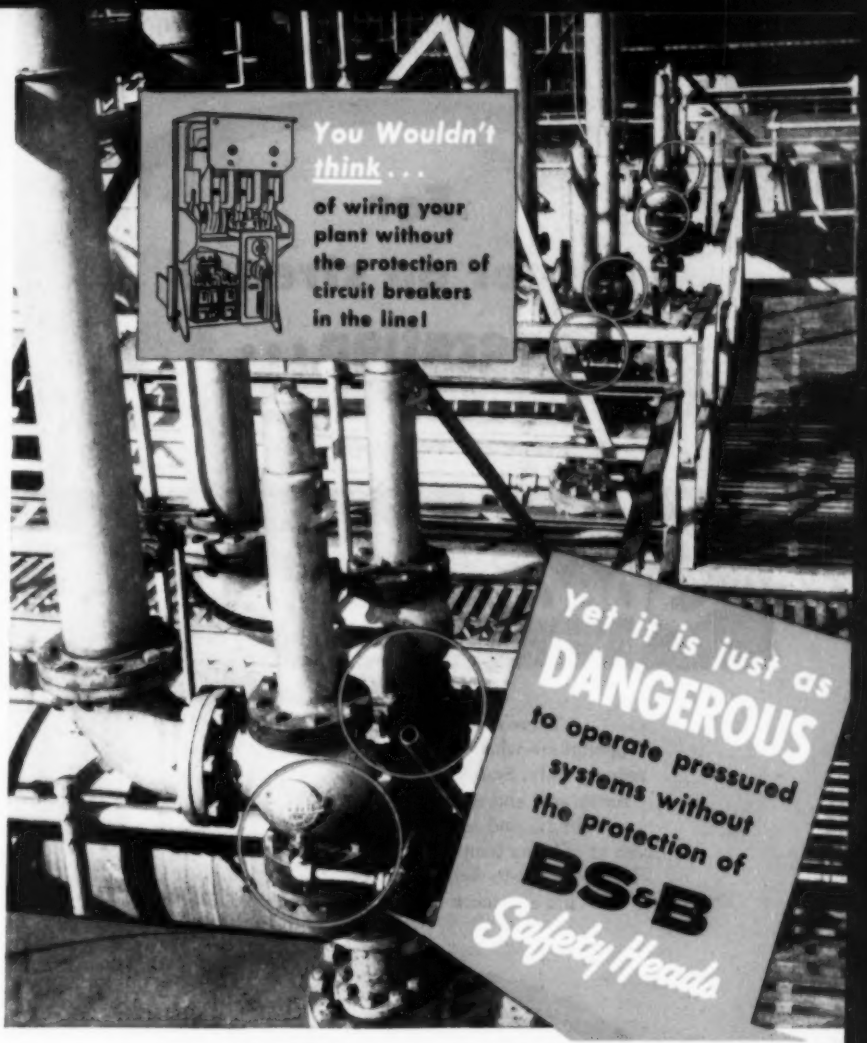
Department Personnel Changes Announced by Union Oil Co.

Union Oil Company of California has announced the following personnel changes in its Manufacturing department.

Elmer B. Palmer, manager of the Los Angeles refinery, transferred to the head office; Henry C. Meiners, manager of the Oleum refinery, will replace Palmer; John W. Towler, chief refining engineer at the Los Angeles refinery, will replace Meiners.

Hundredth Crude Oil Cargo Gets to Anglo-Iranian Plant

Anglo-Iranian Oil Company has announced the arrival of the hundredth cargo of crude oil at its Kent refinery, south of London. Shipped from Kuwait, the cargo brings the total of crude oil delivered to the refinery, the company's newest, to nearly 14,600,000 barrels. The first shipment was received October 31,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What's **Happening . . .**

1952. The refinery began operations last February with the commissioning of its distillation unit.

Spaght Says Atomic Energy Should Receive Oil Welcome

Some markets now served by petroleum may be effectively invaded by atomic energy, Dr. Monroe Spaght, executive vice president of Shell Oil Company, said in a recent speech.

"However, the great market represented by the small prime mover seems to forecast such demands on petroleum that the transfer of the very large power installation to another source of fuel should be welcomed," Spaght said.

If atomic energy supplies some of the demands made on low grade products of refining, he said, it should be an added inducement to the industry to continue aggressively in its program of upgrading the barrel of crude oil for use in its premium markets.

Two Cities Take Action Aimed At Correcting Air Pollution

Air pollution caused by operating catayltic cracking units is being combatted in two United States cities. But, while one city moves towards what may be a solution, the other is being stalled by a flurry of words.

In Cleveland, where the problem came up some time ago, engineering work has been completed and an order has been placed for equipment designed to eliminate the vapor plume on a cat cracker at the Cleveland No. 1 refinery of The Standard Oil Company (Ohio). Sohio's technical service engineers, in conjunction with the Cleveland Division of Air Pollution Control, worked with pilot plant studies to develop methods. Construction of the equipment at a cost of about $400,000 will require up to 18 months.

Meanwhile, the air pollution problem was getting different treatment in the Los Angeles area. Kick-off of a furor came when Pasadena City directors adopted a resolution asking that Los Angeles Basin petroleum refiners return to prewar methods of refining and cracking gasoline as a means of combatting smog. The resolution authorized the city manager to prepare a formal request to the Los Angeles County Air Pollution Control District and County Board of Supervisors. City Manager Don C. McMillan said the request would urge passage of necessary laws forcing abandonment of present catalytic processing methods and restricting current methods of storing and marketing petroleum products.

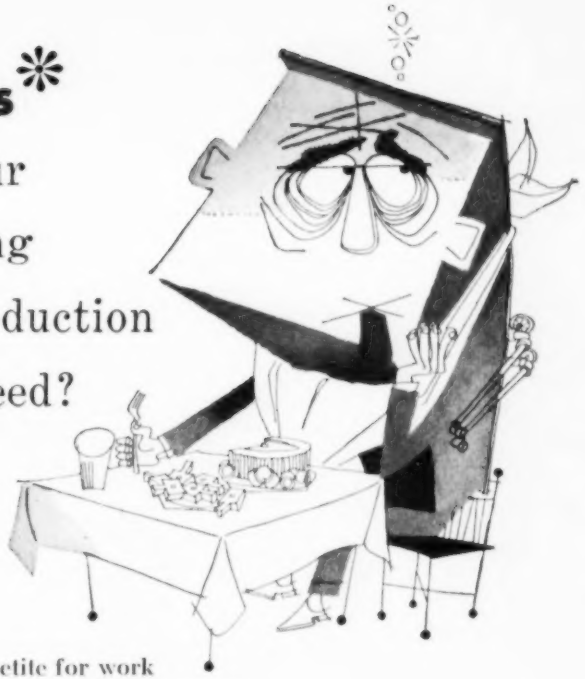
Oil industry leaders voiced strong objections to the demand that they revert to prewar refining methods, and expressed resentment against charges made by McMilllan that public welfare is not considered by refiners. He had said that the "only thing" favoring new cracking processes over the old was economy for companies which now obtain a higher yield of gasoline from a barrel of crude.

The resolution adopted by the Pasadena City directors was based on a study made by Dr. A. J. Haagen-Smit, California Institute of Technology biochemist, who claimed that smog is

does

coil-itis*

have your processing tank production off its feed?



When the appetite for work of your heating and cooling processes diminishes, the trouble may well be coil-itis. For, downtime due to pipe failures and limitations can seriously delay your production flow. Switch to Platecoils, the new tonic for production, as revolutionary as the new wonder drugs. Platecoils take 50% less tank space leaving more room for greater payload. They heat or cool 50% faster. They simplify maintenance and save hours of downtime. Equally important, Platecoils cost as much as 50% less in the first place. Platecoils cure production troubles involving heat transfer and give production a shot in the arm.

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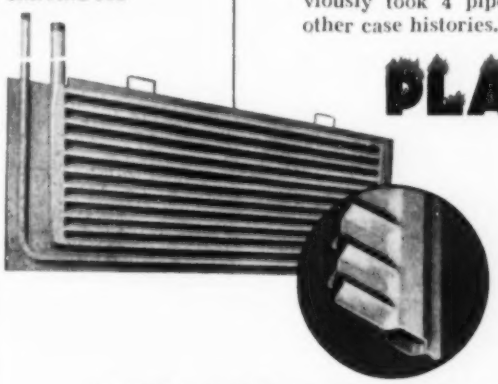

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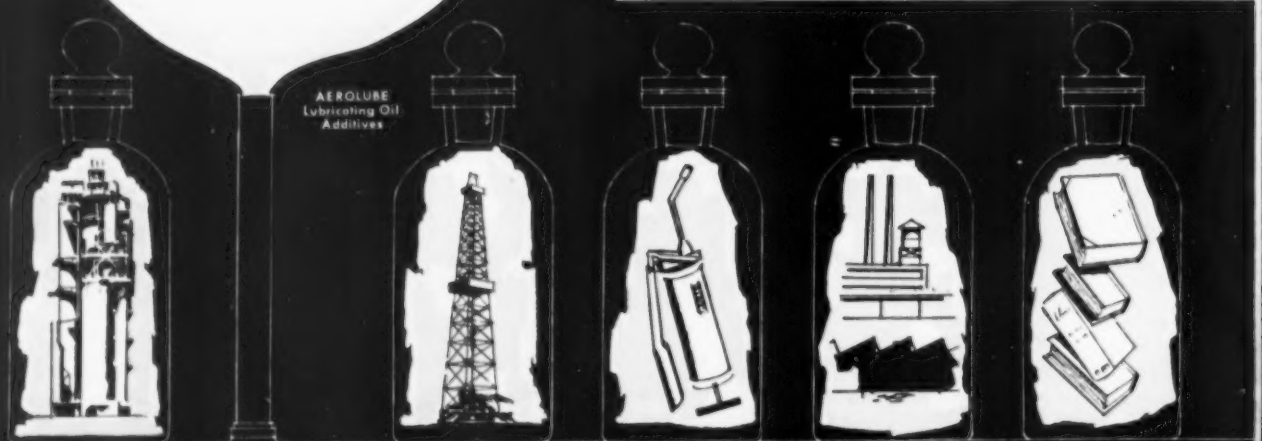

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caused by oxidation in the atmosphere of certain low-molecular weight, unsaturated hydrocarbons or olefins which escape by evaporation from refining, storage and marketing installations and automobile exhaust. McMillan said the studies prove that the new type cracking processes produce more eye-irritating smog than the old process.

Among those attacking the move by Pasadena City was Reese H. Taylor, president of Union Oil Company of California, in his capacity as chairman of the Western Oil & Gas Association Public Relations Committee. Said Taylor: "The suggestion of Pasadena City directors that the oil industry revert to the horse and buggy days of prewar refining hardly merits acknowledgment. It shows a total lack of understanding of the basic nature of the smog problem."

OIIC Names O'Donnell to Fill New Post of Deputy Director

John P. O'Donnell, a sales and oil trade paper executive, has been appointed to the newly created post of deputy director for field activities of the Oil Industry Information Committee. At the same time, the OIIC assigned Donald R. Waugh, for the past two years national field supervisor, to sales manager. Waugh will now handle the sales and distribution of all OIIC materials.

O'Donnell, prior to his affiliation with the oil industry public relations program, had been sales manager of the Export division of Borden Food Products Company.

Appointment of John F. Campbell, of Chicago, as Midwest regional supervisor for the OIIC also has been announced.

Campbell, senior district representative for the OIIC in the Great Lakes district, has been with the Information Committee since June, 1950. He started in the New England office, and was promoted to the Great Lakes area June 1, 1952.

His appointment completes the establishment of a regional supervisory group. Previously announced were the promotions of E. E. Robinson, of Philadelphia, to be Eastern regional supervisor, and M. J. Rupp, of Denver, Colo., to be Western regional supervisor.

Campbell's territory will embrace the Great Lakes, Minnesota-Dakotas, Kentucky-Ohio-Tennessee, and Missouri-Iowa-Nebraska district offices.

Indiana Standard Names Arkis Group Leader at Wood River

J. W. Arkis has become group leader in the Wood River, Ill., laboratory of Standard Oil Company (Indiana). He now supervises technical service in connection with manufacturing heavy oils, additives, and chemicals.

Arkis had been a project chemical engineer at Standard's Whiting, Ind., research laboratories since joining the company in 1946.

Refugio Gasoline Plant Sold

Reiter-Foster Oil Corporation's Refugio, Texas, gasoline plant has been sold for $107,000. Name of the purchaser was not disclosed. The gasoline absorption plant was one of the properties re-

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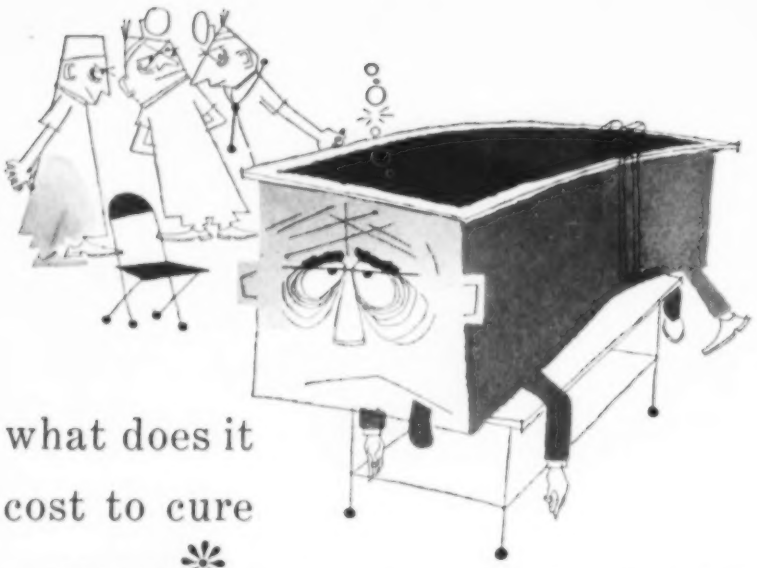


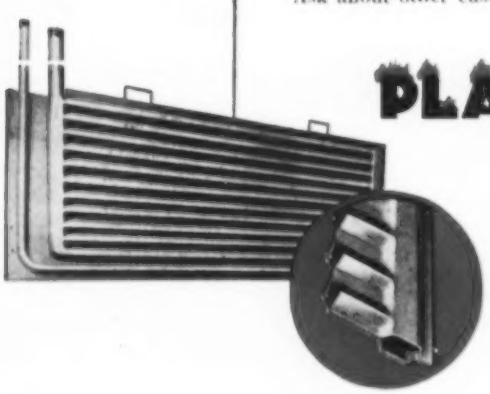
what does it
cost to cure
coil-itis in your processing tank?

The constant care it takes to keep tanks operating when they're plagued with coil-itis is extremely costly. Downtime, and all the other maintenance time, slow heating and cooling ills of using old-fashioned pipe coils can be cured with Platecoils. As revolutionary as the new wonder drugs, Platecoils save as much as 50% in initial cost. They take 50% less space in the tank. They simplify maintenance and save hours of downtime. Compared to the hours it takes to clean and replace pipe coils, Platecoils can be cleaned and replaced in no time at all . . . without dumping the solution. It costs less to cure coil-itis with Platecoils than to suffer its evils. **Write for bulletin P78 today!**

PLATECOILS SAVE 50% IN HEAT TRANSFER COSTS

PLATECOILS COST LESS TO BUY, INSTALL, MAINTAIN

The Newcomb-Detroit Co., Grand Rapids Division, has found it is less costly to buy, install and maintain Platecoils than to fabricate pipe coils in their own plant. Ask about other case histories.



PLATECOIL
REPLACES PIPE COILS

Coil-itis — Diagnosed as tank heating and cooling problems. Platecoils — the prescription for solving pipe coil problems.

What's **Happening** . . .

ceived by Reiter-Foster as a result of a five-year litigation concluded last January.

California Standard Plans Big Outlay for Refinery Units

One of the largest expenditures in Standard Oil Company of California's 1954 budget will be new refinery plant construction, R. G. Follis, board chairman, has reported.

Some of the most costly refinery units the company has ever built will be completed or substantially completed during 1954, he said. The projects are necessary to the company's various programs of expansion and diversification, he explained, and "we're concentrating our 1954 program on bringing them into operation as rapidly as we can."

Foremost in California Standard's refinery plans is the completion of various units to increase the quality and octane ratings of motor gasoline. Also, the company is adding several new chemical units "to continue the development and growth" of its petrochemical business.

Proposals for Shale Oil Plant Gets Cool Interior Reception

Immediate construction of a full-scale shale oil plant as a joint project by the petroleum industry and the Defense Department has been advocated by A. C. Rubel, exploration and production vice president of Union Oil Company of California. Addressing the petroleum branch of AIME, he proposed a 10,000-barrel-a-day plant involving a capital outlay of $10 million to $50 million. Industry, he said, should design, build and operate the plant on a cost basis without profit. Much of the output, particularly diesel oil, could be sold to railroads and industries; jet fuel could be taken by the Air Force, and other products could be shipped perhaps at a loss to available markets, he said.

Several Interior Department officials reacted to Rubel's proposal by expressing doubts that the government would or could participate with the petroleum industry in such a venture. They pointed out that present department policy is to limit the government role in synthetic fields to basic research and small scale experimentation. They indicated that unless the Interior Department does an about-face on policy, it would not likely be willing to take part in the proposed project.

Later in the month, speaking in Denver, Assistant Interior Secretary Felix E. Wormser said that the government has no intention of going into commercial production of oil from shale. These views are about the same as expressed earlier by Interior Secretary McKay.

Under Rubel's plan, losses of the proposed shale oil plant would be absorbed by the Defense Department in the same manner as other stand-by items are handled by that agency.

He estimated the transition from pilot plant to full-scale operation would require two to five years with tht Defense Department financing preliminary development of liquid fuels from shale by cooperation with industry to the extent of underwriting construction and absorbing

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2. **Maneuverability** — Extremely short tail swing (about 4½ ft.), low overall height plus boom telescope permit maneuvering that stops other outfits cold.
3. **Stability** — Four husky outriggers extend and retract hydraulically in seconds — permit leveling crane from operator's station . . . give Hydrocrane exceptional lifting capacity.
4. **Mobility** — Can travel along open highways at speeds up to 50 mph, maneuvers in traffic easy as light truck.
5. **"Control-ability"** — Fully hydraulic, for "hair line" precision control. Simple hand levers only — no foot brakes. New operators have learned to run it in a few hours.
6. **Convertibility** — Crane has actually been converted to Hydrohoe front end *by one man in less than one hour!* On trenching, telescoping boom cuts lost time on move-ups by 40 percent.

REFINERY-PROVED

ON ALL THESE JOBS

Moving heat exchangers
Handling condensers
Setting valves and pipe
Stockpiling material
Erecting tank foundations
Trenching

Get the full story on the Hydrocrane with its many attachments.
SEND COUPON TODAY . . .

BUCYRUS-ERIE COMPANY
South Milwaukee, Wisconsin

Gentlemen: ☐ Please send me Hydrocrane literature.
☐ Please send me Hydrohoe literature.

Name.....

Title.....

Address.....

City..... State.....

10H53

Bucyrus-Erie Company
South Milwaukee, Wisconsin

SEALOL

flexibox

WORLD'S FOREMOST MECHANICAL SEAL FOR PROCESS PUMPS . . .

SEALOL — exclusive representative in the United States and Canada for Flexibox — offers the oil refinery industry a complete and tested line of mechanical seals for process pumps. Flexibox Seals come to this country with over 15 years of actual oil refinery service behind them. They afford safety and security never before obtainable with conventional stuffing boxes.

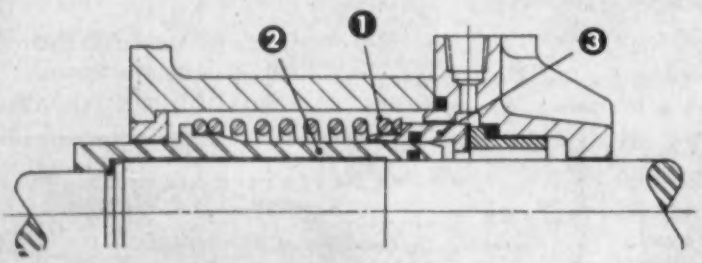
Flexibox Seals are simple and rugged — their unique spring drive reduces mechanical components to a minimum. There are no rubber sleeves or bellows — no keys, pins, slots or grooves. With the Flexibox Type RR seals (shown below) sleeves are furnished as a component of the seal assembly. No pump sleeve required. Designed especially for each installation — no measurements are required for assembly. Seals are supplied with a novel circulating arrangement which assures liquid at the seal faces at all times, removing frictional heat and reducing wear.

Many major oil refining companies throughout England, on the Continent, and in South and Central America have standardized on Flexibox mechanical seals for their process pumps. Write for Bulletin 9. Sealol Corporation, 13 Willard Avenue, Providence 5, Rhode Island. Chicago • Cleveland • Houston • Los Angeles Philadelphia • Tulsa • Montreal, Canada. Flexibox, Ltd., Manchester, England.

OPERATING PRINCIPLE OF FLEXIBOX SEALS

The spring ❶ engages the shaft sleeve ❷ at one end and the neck of the rotary seal ring ❸ at the other with interference fits. In operation the coils tend to "wind up", thus further increasing their grip. Consequently, the rotary seal ring ❸ is driven positively yet resiliently.

flexibox



SEALOL

THE BALANCED PRESSURE SEAL

What's **Happening** . . .

the operation deficit "to insure the successful transition."

Rubel explained that a 50,000-barrel-a-day plant costing $300 million would be necessary for a commercial venture because the output would have to be pipelined to consumer markets, and it would require that volume to justify a pipe line (800 to 1000 miles, either to Southern California, Mid-Continent, or Chicago from Colorado).

API Refining Division Will Begin New Abstract Service

The Division of Refining of the American Petroleum Institute has announced that its new Technical Abstract Service will be inaugurated in January.

Designed to save time, money and effort for its subscribers, the new service will cover 100 of the most useful petroleum and chemical publications. A bulletin will be published weekly and multiple copies will be sent to subscribers.

The service is being established at the request of the industry, and as a result of several years of study by various committees in the Institute. Subscriptions will not be confined to the oil industry, however, and all interested parties may obtain the service by contacting the Division of Refining.

By covering the petroleum journals, and abstracting the contents, the new Technical Abstract Service, according to the Division of Refining, will provide many advantages to subscribers. Some of them: companies will save money on time used by their men in looking through journals; the problem of missing worthwhile items because of too little time to read so much will be solved; faster coverage of the literature will be achieved; a high grade of abstract will be made available; economic waste from duplication of work among companies now abstracting for their own use will be eliminated; and large companies now abstracting these journals will save up to 90 percent of the cost of such service.

Sample copies of the bulletin and additional information may be obtained by writing to Louis C. Stork, Editor, Technical Abstract Service, American Petroleum Institute, 50 West 50th Street, New York 20, N. Y.

PAD May Still Get Budget Though Termination Date Set

Deputy PAD LaFortune has informed the Budget Bureau that present plans call for wrapping up the agency by December 31. This may mean that a new PAD budget will not be submitted. Instead, the Interior Department would submit a budget for the successor agency (apparently Oil and Gas Division) to accommodate defense activities it would inherit. PAD is now waiting for word from the Budget Bureau on whether a new budget should be submitted, regardless of life expectancy. If this is done, and PAD later terminated, Interior Secretary McKay would transfer oil defense funds to the successor agency.

Halley Joins Indiana Standard As New Industrial Hygienist

Standard Oil Company (Indiana) has named Paul D. Halley to the position of industrial hygienist. Halley will seek new ways to guard the health and

Another reason why

Chase

Antimonial Admiralty Tubes last longer!

Yes, you can *count* on Chase Antimonial Admiralty Heat Exchanger Tubes to give you many years of satisfactory service.

Chase Heat Exchanger Tubes are rigidly controlled for quality during manufacture, and various tests are applied when the tube is finished. The flattening test mentioned below is a good example. Wall thickness, diameter, surface finish, concentricity and accuracy of length are carefully determined.

So, for Heat Exchanger tubes that last and last, *remember:* insist on Chase Antimonial Admiralty!

PUTTING THE SQUEEZE ON IMPERFECTIONS...
This Chase technician is performing a "flattening test" which is an indication of soundness and freedom from hidden defects. You are assured that tubes passing this test will satisfactorily withstand bending or end flaring.

Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

CHASE WAREHOUSE STOCKS:
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Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester† St. Louis San Francisco Seattle Waterbury †sales office only

Graphic control . . . *for leading industries*

The well-established trend to centralized graphic instrumentation has brought with it many specific advantages to the operation of complex, modern processing units. And to realize most fully the potential advantages of improved efficiency, simpler supervision and better coordination, many leading companies have turned to Honeywell graphic control.

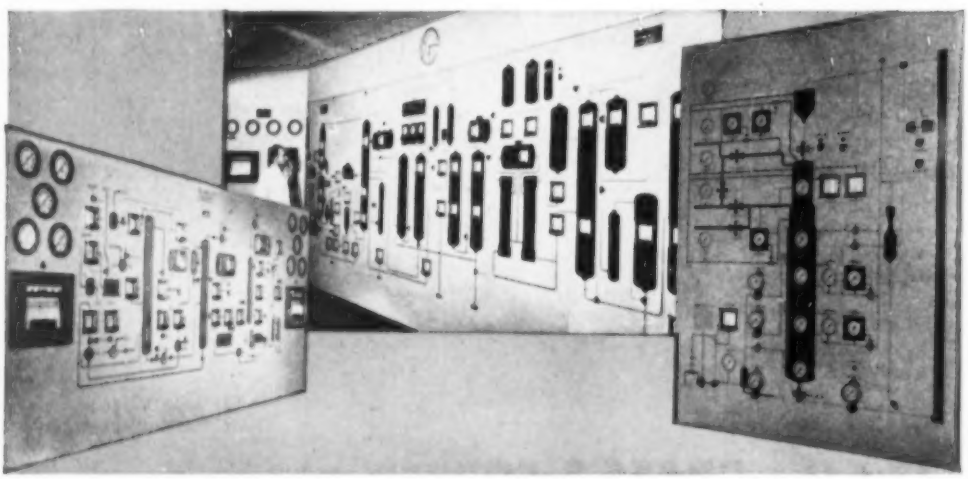
Among the engineering, construction and producing organizations which use Honeywell panels are some of the best-known names in their fields. The ever growing list includes:

C. F. Braun
Catalytic Construction Co.
The Fluor Corporation Ltd.
Foster Wheeler Corp.
Gulf Oil Corporation
Imperial Oil of Canada
M. W. Kellogg
The Lummus Co.
Pan-Am, Southern
Phillips Petroleum Co.
The Refinery Engineering Co.
Shell Oil Co.
Sinclair Refining Co.
Socony-Vacuum Oil Co.
Standard Oil Co. of California
Standard Oil Co. of Indiana
Standard Oil Co. of New Jersey
The Texas Company
Tide Water Associated Oil Company
Union Oil Co. of California

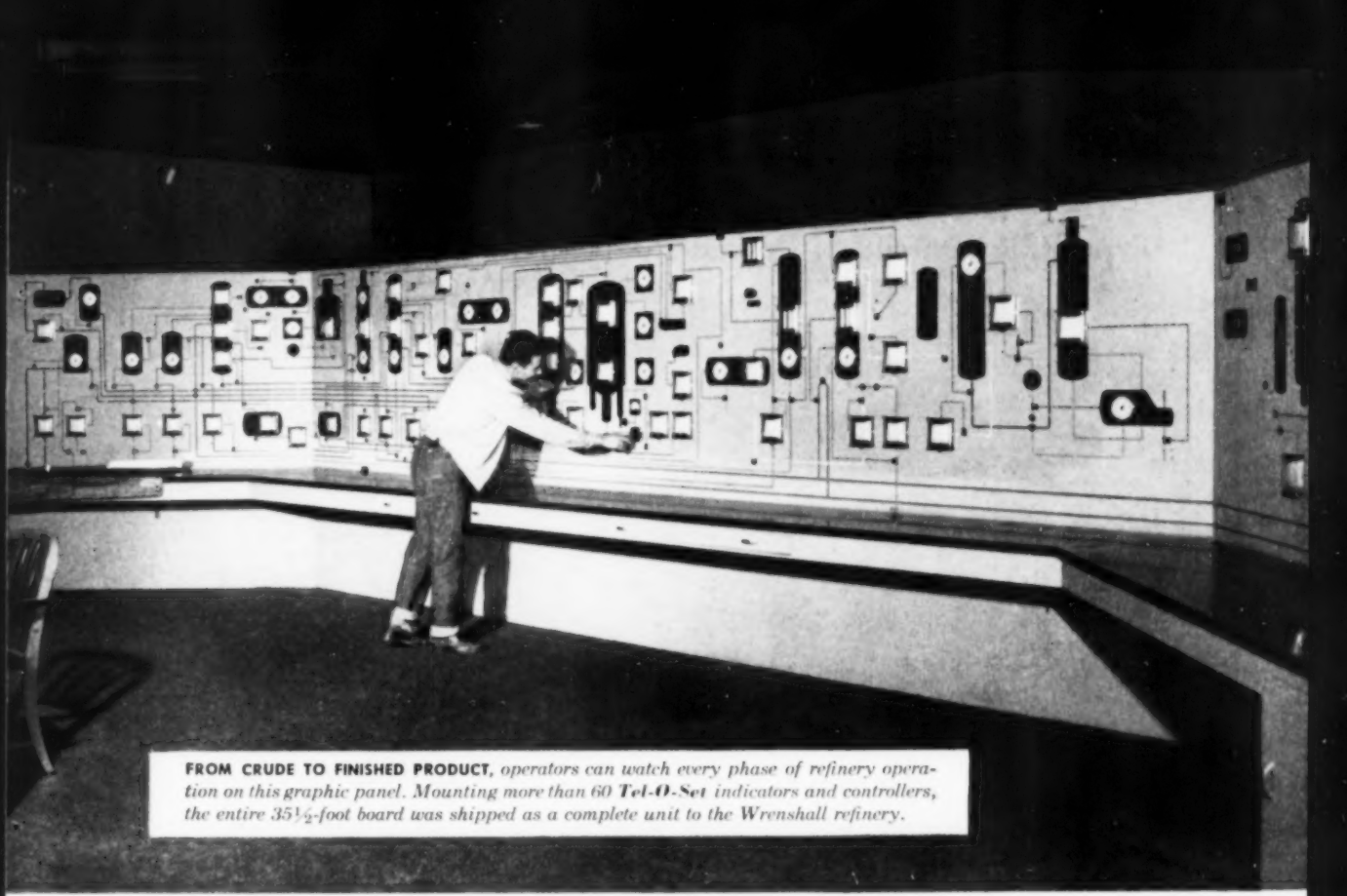
Reasons for acceptance

Behind this industry-wide acceptance stand several definite reasons. First is system engineering . . . by graphic panel specialists who translate process requirements into an integrated, harmonious design. Second is instrumentation . . . including a full line of *Tel-O-Set* miniature indicators, recorders and controllers, and *ElectroniK* instruments for supplementary recording, which enable Honeywell to satisfy the requirements of every phase of process control. And third is workmanship . . . skilled assembly either in a manufacturing department devoted exclusively to this work, or, if desired, at the job site by our own experienced branch installation crews—an organization built up over 15 years for the installation of industrial and commercial control systems.

Graphic control *centralized*



FUNCTIONAL DESIGN *for maximum efficiency is the keynote of Honeywell graphic instrumentation. These typical panels show a few of the varied types which have been built for varied process applications.*



FROM CRUDE TO FINISHED PRODUCT, *operators can watch every phase of refinery operation on this graphic panel. Mounting more than 60* ***Tel-O-Set*** *indicators and controllers, the entire 35½-foot board was shipped as a complete unit to the Wrenshall refinery.*

for complete refinery *on a single Honeywell panel*

THE MOST up-to-date concepts of petroleum processing were embodied in International Refineries' new plant at Wrenshall, Minnesota. Designed and built by the Lummus Company, this refinery produces straight run, cracked and polymer gasolines, diesel and other fuel oils, all of which are distributed by Western Oil & Fuel Co.

An outstanding feature of this new refinery is its continuous flow operation . . . no intermediate storage tanks are needed between processing stages. This "straight through" design naturally calls for precise, closely integrated control of related processes. To meet these exacting control requirements, refinery and design officials selected Honeywell graphic control.

The big graphic panel shown above combines all the instrumentation for eight different refining processes. Operators can follow the entire functioning of the plant from crude to finished products, from this single control center. Worked out in detail by Honeywell design specialists, this panel does the job that would ordinarily require four or more separate panels. Not only were substantial savings effected in space, but the panel affords complete centralization of plant control . . . flexibility to meet seasonal variations in product demand . . . and maximum efficiency of process supervision, both for operators and for management personnel.

Your nearby Honeywell sales engineer will welcome the opportunity to discuss your graphic control requirements. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4498 Wayne Ave., Philadelphia 44, Penna.

● **REFERENCE DATA:** Write for Bulletin 85-20, "Centralized Instrumentation . . . unlimited."

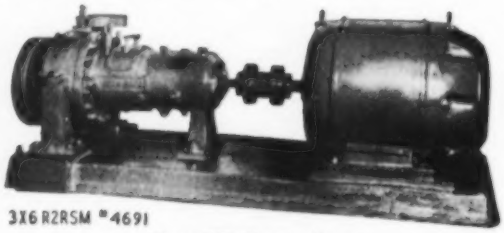
MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

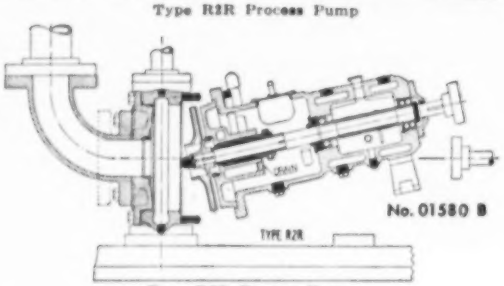
First in Controls

DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



Type R2R Process Pump



Type R2R Process Pump

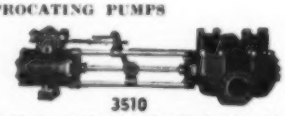
DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE: Type R2R. Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.
Capacities: 50 to 2000 Gallons per minute. Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

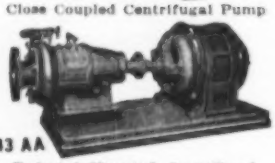
BUILDERS OF OUTSTANDING PUMPS SINCE 1869

CENTRIFUGAL and RECIPROCATING PUMPS

4046M
Close Coupled Centrifugal Pump

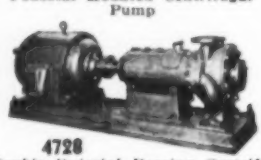


3510
Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids



4043 AA
Pedestal Mounted Centrifugal Pump

3833
Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump



4728
Double Pedestal Bearing Centrifugal Pump

3554
Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

323 W TENTH ST.

Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

What's **Happening** . . .

safety of employes at refineries and other company locations. He will check such factors as temperature, sanitation, lighting, ventilation, noise, and the possibility of exposure to toxic substances.

Headquartered at Standard's Chicago general office in the Medical department, he also will coordinate Standard's operations with health regulations in several states.

Halley was formerly acting associate director of the bureau of industrial hygiene in the West Virginia Department of Health.

Industrial Executives Named Trustees of Gas Institute

Three industrial executives were named to the board of trustees of the Institute of Gas Technology at Illinois Institute of Technology during the Gas Institute's 12th annual meeting last month.

They are Carl Sharp, chairman of the board of Acme Steel Company, Chicago; R. M. Heskett, president of Montana-Dakota Utilities Company, Minneapolis; and John E. Heyke, Jr., president of Brooklyn Union Gas Company, Brooklyn.

Sharp replaces Wilfred Sykes, director of Inland Steel Company, Chicago, who resigned after serving one year of his three-year term. Sykes had served on the board since the Gas Institute was formed in 1941.

Heskett takes the place of John L. Holloway, president of Crane Company, Chicago, only one of the nine trustees whose terms expire this year who did not seek reelection. Heskett also is a member of the IIT board of trustees.

Heyke succeeds the late Hugh H. Cuthrell, who was chairman of the board of Brooklyn Union Gas Company until his death August 31.

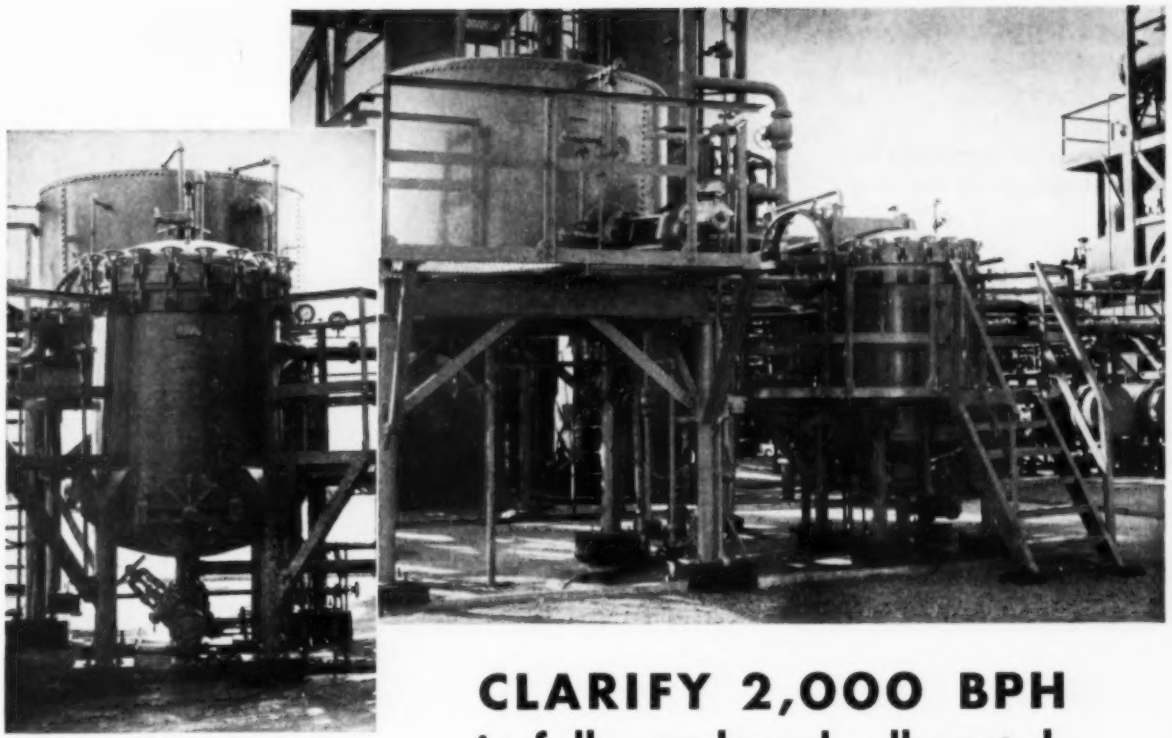
The following trustees whose terms expire this year were reelected for three-year terms:

Frank H. Adams, president, Surface Combustion Corporation, Toledo, Ohio; Walter C. Beckjord, president, Cincinnati Gas & Electric Company, Cincinnati; Alexander M. Beebee, president, Rochester Gas and Electric Corporation, Rochester, N. Y.; Thomas Drever, chairman of the board, American Steel Foundries, Chicago; N. Henry Gellert, president, Seattle Gas Company, Seattle; N. C. McGowen, president, United Gas Pipe Line Company, Shreveport, La.; Frank C. Smith, president, Houston Natural Gas Corporation, Houston; and Harry K. Wrench, president, Minneapolis Gas Company, Minneapolis.

The board of trustees reappointed Frank H. Lerch, Jr., director, Consolidated Natural Gas Company, New York, its chairman and Raymond J. Spaeth, vice president and treasurer of Illinois Tech, secretary-treasurer.

Named to the executive committee of the board of the Gas Institute were Sharp and E. J. Boothby, president of Washington Gas Light Company, Washington, D. C. Sharp replaces Sykes, and Boothby, already a member of the board, succeeds Beebee, who resigned his committee post.

Other members of the nine-man committee, which determines Gas Institute policy, are Lerch, Adams, Drever, Smith, Dr. John T. Rettaliata, James Cunningham, president, Republic Flow Meters Company, Chicago, and James



NIAGARA FILTER in refinery service removes troublesome iron sulfide particles from recycled solutizer solution. The filter permits this solutizer plant to operate uninterruptedly 64 hours at a time.

CLARIFY 2,000 BPH
in fully-enclosed, all-metal, corrosion-resistant filter

YOU CAN TEST modern pressure-leaf filtration, under controlled conditions, with accurate scale model Niagara pilot plant filters, for rent in various sizes and styles.

If you want to remove minute solid particles from recycled streams, or other liquids, consider what a Niagara Filter will do for you.

It removes all micronic particles from liquids, at flow rates as high as 2,000 BPH per filter unit. It discharges solids rapidly, for disposal or recovery in dry or slurried form. It is easily applied to continuous or batch operations. *You save labor, construction cost.*

Usually, only ten minutes are needed to remove solids at the end of each cycle. One man does the job easily without help, because there are no cloths or heavy units to remove, handle, and replace.

You save on first cost, too, by specifying Niagara for corrosion-resistant service. The filter is all-metal, totally-enclosed, leakproof. The simple all-welded tank is easily constructed to specification, in steel or a wide choice of alloys. Jacketing and synthetic linings can also be furnished, at extremely low cost for this type of equipment.

To get a fuller idea of how Niagara Filters can save you process time and cost, write today for catalog information.

FOR YOUR FILTRATION FILE . . . *Complete new 20-page catalog illustrates and describes principles and methods of pressure-leaf filtration; lists typical applications; fully describes the many sizes, styles and modifications available in the Niagara line; and details five filtration services available to you. Send the coupon for your copy today.*

Niagara Filters
DIVISION
AMERICAN MACHINE AND METALS, INC.
EAST MOLINE, ILLINOIS

IN EUROPE: **Niagara Filters Europe, Post Box 1109, Amsterdam-C, Holland**

NIAGARA FILTERS Division, American Machine and Metals, Inc.
Dept. PR-1153, East Moline, Illinois
Please send, without obligation, Catalog NC-1-53.

Name_____

Title_____

Company_____

Address_____

City_____ Zone____ State_____

What's **Happening** . . .

F. Oates, Jr., chairman of the board, Peoples Gas Light and Coke Company, Chicago.

University of Pittsburgh Will Erect Engineering Building

The University of Pittsburgh has let contracts totaling $1,195,087 for the construction of a building which will serve as headquarters for its schools of engineering and mines.

Construction of the building, which will be erected on the Oakland campus, connecting and partly overlapping the present Old Mellon Institute and Thaw Hall, will begin early this month.

The new engineering building will house research and laboratory space, hydraulics laboratory, strength of materials laboratory, soil laboratory, and chemical engineering laboratory. The wind tunnel for aeronautical engineering will also be housed in one section of the building. Total floor area is approximately 61,300 square feet.

Brown Urges Oil Industry to Fight Every Regulation Attempt

The oil industry must fight the idea that the federal government should run anything important, Bruce K. Brown, Pan-Am Southern Corporation president, said in a recent Oil Progress Week talk. Industry must bring out the truth that the petroleum business has reached its present size only because it has remained "free" of governmental domination, he said.

California Standard Wins Safety Awards—

For its work record of 3,246,814 man-hours without a disabling injury, Standard Oil Company of California's Richmond, Calif., refinery has been presented the National Safety Council and the API accident prevention awards.

Above, T. S. Petersen, second from right, president of Standard of California, displays the awards to other company officials. Left to right are: O. N. Miller, Manufacturing department manager; R. E. Donovan, Safety division manager; T. E. Flowers, refinery safety engineer; R. K. Rowell, refinery manager; G. A. Davidson, vice president; Petersen; and W. W. Davison, vice president.

The Standard refinery's record, set between January 15 and June 20, is the third best in the history of U. S. refineries.

Bowman Joins Ralph Parsons

Thomas P. Bowman has joined The Ralph M. Parsons Company as an assistant to Harry P. Broom, vice president in charge of Parsons' New York office. For the past eight years Bowman has been as-

Streamline Welded
TRADE MARK

CATALYST CHAMBER

5'0" x 37'0"—800 psi

Weight 70,000 lbs.

1-3/16" Shell, 2¼" Conical Heads

API-ASME CODE

PROCESS EQUIPMENT

AND

PRESSURE VESSELS

F & T Products

Absorption Towers	Autoclaves
Alloy Steel Equipment	Bubble Towers
Butane Storage Tanks	Catalysts
Fractionating Columns	Heater Changers
Heating Boilers	Jacketed Vessels
Oil Country Boilers	Power Boilers
Recirculating Furnaces	Tanks

Waste Heat Boilers

FARRAR & TREFTS INC.

Established 1863

Buffalo 12, New York

BEAIRD-INGERSOLL-RAND

Packaged Compressor Plant

Lowest Cost Per Horsepower Installed

These two 330 h.p. packaged compressor plants, each with three stages of compression, were completely assembled at the Beaird factory. Each includes Ingersoll-Rand gas engine driven compressor, Young radiator, and all components, connections and controls normally found in a compressor station. Other sizes from 110 h.p. to 550 h.p.

REEF FIELDS GASOLINE CORPORATION operates this compressor station in Hobo Field, Texas. But operation does not require a full time attendant — it requires only periodic inspections by field personnel who live several miles away at another field. For these Beaird-Ingersoll-Rand packaged compressor plants are equipped with special controls which make a regular attendant unnecessary. Automatic speed and pressure regulators on their flexible 4-cycle engines, increase or decrease speed to handle the fluctuating volume of gas. And automatic shut-down devices stand guard to protect the units against damage from any unusual operating conditions which might develop.

These automatic controls are but a few of the many advantages of Beaird-Ingersoll-Rand packaged compressor plants. Let us tell you all the facts.

Require little attention —

TWO PACKAGED PLANTS HANDLE VARIABLE LOADS AUTOMATICALLY

THE J. B. BEAIRD COMPANY, INC.

SHREVEPORT, LOUISIANA

BEAIRD

MACHINING MANUFACTURING STEEL WAREHOUSE

PACKAGED COMPRESSOR PLANTS

CAST STEEL FITTINGS

PRESSURE BULK STORAGE

ANHYDROUS AMMONIA EQUIPMENT

LP GAS SYSTEMS

BEAIRD Pressure Storage Tanks

Engineered For Safe Storage

Now ALL Beaird Tanks are X-rayed

You know the advantage of having all shell seams on pressure tanks X-rayed. And now that is standard practice on all our large LP-Gas and anhydrous ammonia tanks — not just spot X-raying — but complete X-raying of entire shell seams. For example, on each 30,000-gallon tank, over 200 separate films are exposed, developed and individually inspected. With these films, our inspectors can literally see through every inch of seam on the entire shell. They know the welding is sound.

That is why we have gone to the expense of installing the most modern radiographic equipment — to assure you that the Beaird tanks you receive are engineered and manufactured for safe storage.

Let us quote you on your pressure storage requirements.

THE J. B. BEAIRD COMPANY, INC.
SHREVEPORT, LOUISIANA

BEAIRD

MACHINING MANUFACTURING STEEL WAREHOUSE

PACKAGED COMPRESSOR PLANTS

CAST STEEL FITTINGS

PRESSURE BULK STORAGE

ANHYDROUS AMMONIA EQUIPMENT

LP-GAS SYSTEMS

sociated with Foster Wheeler Corporation as a project engineer on oil refinery and chemical plant work.

Sinclair Promotes Hill to Top Manufacturing Position

Sinclair Refining Company has appointed Aubrey (Abe) D. Hill assistant manager of manufacturing, lubricating oils and waxes for all Sinclair refineries. Joining the Sinclair organization at its East Chicago refinery in the Development department in 1923, Hill was later transferred to the company's Coffeyville, Kan., refinery, and still later to its Houston refinery. At Coffeyville and Houston he worked in the company's lubricating oil and wax production.

Hill

Following advancement through positions at Sinclair's Wellsville, N. Y., refinery, he joined the company's New York office in 1944 in the division of manufacturing of lubricating oils and waxes, which position he held prior to his recent appointment.

David Brown Takes Post with Scientific Design Company

Scientific Design Company, Inc., has appointed David Brown director of process development.

Previously, Brown served with Shell Development Company as senior development engineer in the Process Engineering department. He also was associated with The M. W. Kellogg Company as an engineer. Prior to Navy service he was with Thompson Weinman & Company as a chemist and Standard Oil Company of California as an engineer.

Tide Water Associated Names R. D. Rogers Vice President

R. D. Rogers has been appointed a vice president of Tide Water Associated Oil Company, and vice chairman of the operating committee, Eastern division.

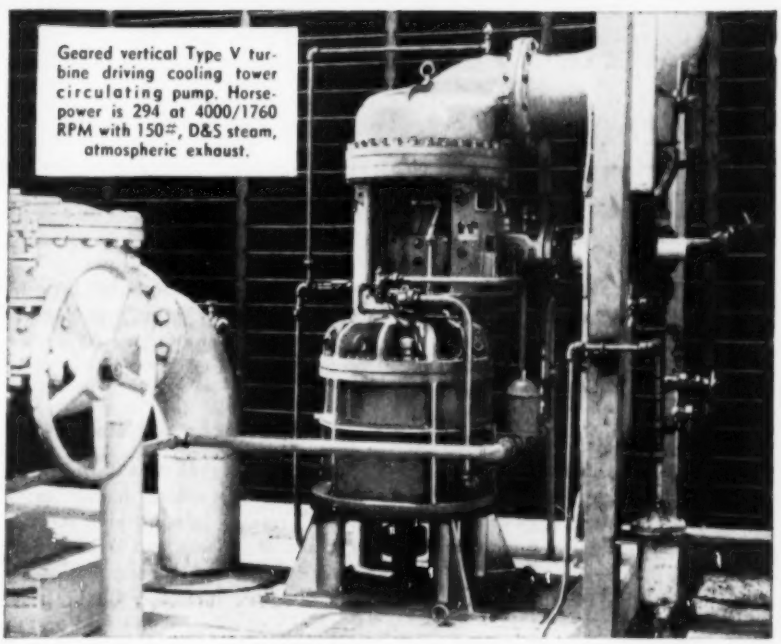
Rogers, recently appointed manager of the transportation and supply department, Eastern division, has been in the service of Tide Water Associated and its predecessor companies for more than 30 years. He has had wide experience in the refining and sales departments of the Eastern division.

Stauffer Made Patent Attorney In Indiana Standard Changes

J. C. Stauffer has become a patent attorney for Standard Oil Company (Indiana) in the general office at Chicago. D. R. Carmody, a group leader, has succeeded him as a senior patent advisor at the company's Whiting, Ind., research laboratories. R. M. Alm, a chemist, has been appointed a group leader in the Chemical Products divsion at the Whiting laboratories.

Dr. Stauffer joined Standard in 1928

Murray Turbines



Geared vertical Type V turbine driving cooling tower circulating pump. Horsepower is 294 at 4000/1760 RPM with 150#, D&S steam, atmospheric exhaust.

● Murray Vertical V turbines, both geared and direct-connected, are being used more and more for driving vertical pumps of all types. The Murray Vertical V turbine is designed from top to bottom as a vertical turbine, not just a horizontal turbine, "upended." The Murray Vertical is especially constructed and arranged for vertical mounting.

Murray vertical turbines can be furnished for steam pressures up to 600#, 750° F. TT. and back pressures as high as 100# and can carry most normal thrust loads imposed by vertical pumps.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

CLARK UTILITRUCS handle the toughest jobs at least cost!

...they're engineered to satisfy driver, maintenance man, management

Here are the most advanced 6000-7000 lb. fork trucks on the market today—Clark's gas or electric UTILITRUCS. Built to handle jobs that break the backs of less rugged trucks, these UTILITRUCS have proved their superiority in foundries, steel mills, stevedoring* and heavy warehousing. They represent an ideal balance of essential engineering features. They get more work done at less cost, for these reasons:

1. Easier to drive

All controls at the driver's fingertips, like an automobile; compact and more maneuverable; shockless steering; increased braking efficiency; 140 sq. inches additional visibility; 25 inches of free-lift; DYNATORK or HYDRATORK DRIVE available on gas model.

2. Easier to service

Complete accessibility for maintenance. On gas model: one-piece "zipper" hood folds back to expose engine; one-piece floorboard lifts up to expose master cylinder and transmission; swing-out battery. All service points easy to reach.

3. Built to take punishment

Welded, integral-unit box frame eliminates distortion; higher inch-pound rating; axle-to-frame mounting absorbs shocks and strains; new design wheel and backing plate seals out dirt and abrasives. Oil bath air cleaner and oil filter standard on gas model. Totally-enclosed drive motor, sealed-for-life bearings on electric model.

We invite you to compare the UTILITRUCS to any 6000-7000 lb. truck on the market! Without obligation, you can discuss them with your nearby Clark dealer, listed in the Yellow Pages of your phone book. Or write us for free descriptive literature.

*Special stevedoring model available

1903 1953 CLARK EQUIPMENT

CLARK EQUIPMENT

Industrial Truck Division
CLARK EQUIPMENT COMPANY
Battle Creek 161, Michigan

What's **Happening** . . .

as a chemical engineer; Dr. Carmody started as a chemist in 1950; and Dr. Alm began with the company as a chemist in 1948.

Mines Bureau Reports Demand For Domestic Crude Steady

Domestic crude to be consumed or exported in November will average 6,550,000 barrels a day, or about the same as October, the Bureau of Mines has forecast. Included are the total gasoline demand of 104.6 million barrels in November, the gasoline yield of 44 percent and the total crude runs of 7,110,000 barrels a day.

Total crude runs averaged 7,163,000 barrels a day in August, were cut to 7,040,000 in September, and for the first half of October averaged about 6,900,000 barrels a day, the Bureau reported.

Organizational Changes Made By Pan American Petroleum

Pan American Petroleum & Transport Company and its refining subsidiary, Pan American Refining Corporation, have announced reorganizational changes within the two companies.

L. W. Moore, president of Pan American Refining and Mexican Petroleum Corporation of Georgia, has been elected first vice president of Pan American Petroleum. He will continue in his present position. He will also continue as a director of the refining company and Mexican Petroleum as well as Pan American Gas Company and Pan American Production Company. Moore joined Pan American's parent company, Standard Oil Company (Indiana) in 1933, transferring to Pan American in 1935.

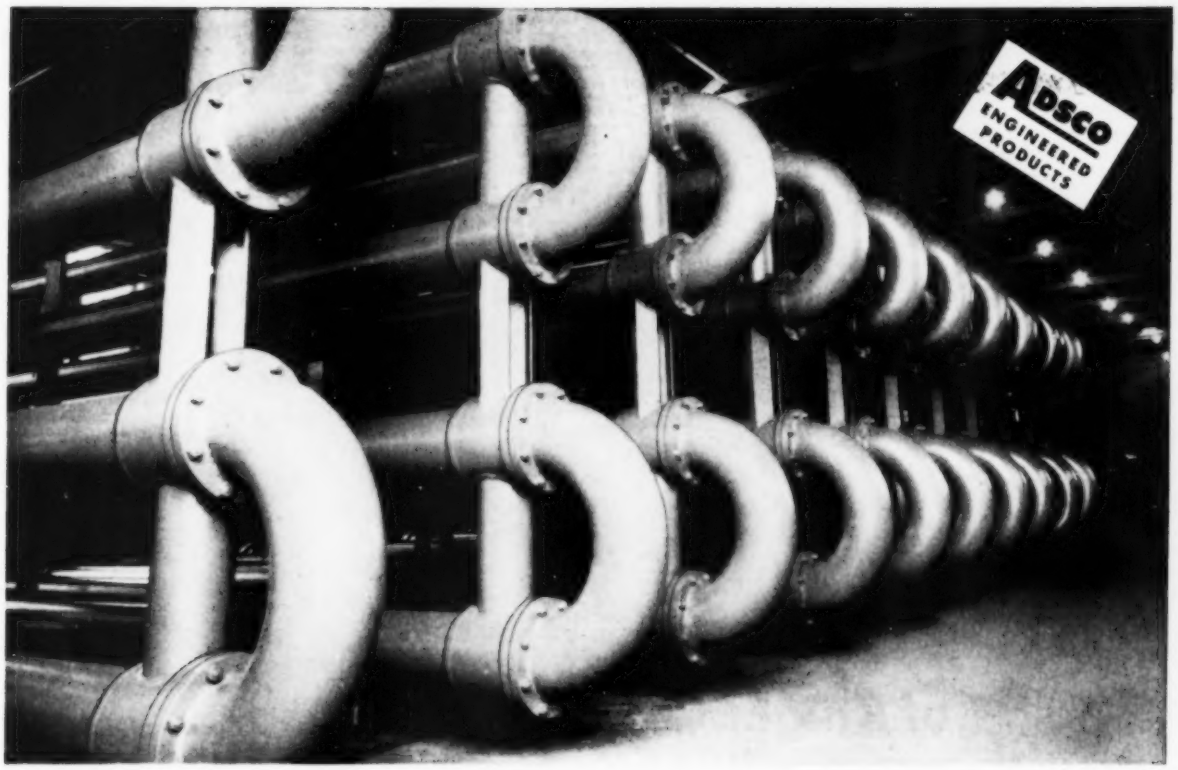
Dr. Harold R. Snow, in addition to his position as vice president of Pan American Refining and Mexican Petroleum, will now be general manager of manufacturing, with offices in New York. Snow started his oil career at Indiana Standard's Whiting refinery. He has recently been general manager of Pan American's largest refinery at Texas City, Texas.

S. B. Schapiro, previously general superintendent of the Texas City plant, has been appointed manager of engineering, construction and maintenance for Pan American Refining Corporation. Schapiro, whose first job was with Mexican Petroleum, will be in charge of these activities at the companies' refineries at Texas City, Savannah, Georgia, Baltimore, and the one which is now scheduled to be built at Goodwin Neck near Yorktown, Virginia.

Paul F. Miller, assistant general superintendent at Texas City, will become manager of industrial relations for all four refineries, effective January 1, 1954. Miller began at Indiana Standard's Whiting plant and was transferred to Texas City in 1936.

B. G. Babin, formerly assistant general superintendent at Texas City, has been named plant manager, and W. W. Peeler, previously operating superintendent, has become general superintendent. Babin entered the oil business at Mexican Petroleum's Destrehan, La., refinery, was transferred to Texas City as personnel supervisor in 1933. Peeler has been at Pan American's Texas City plant since 1934.

M. C. Hopkins, technical director, Research and Development department, at Texas City since 1951, has been named



NEW CELLULOSE PLANT SALVAGES MAXIMUM HEAT WITH THESE 40 ADSCO HEAT EXCHANGERS STACKED IN SERIES

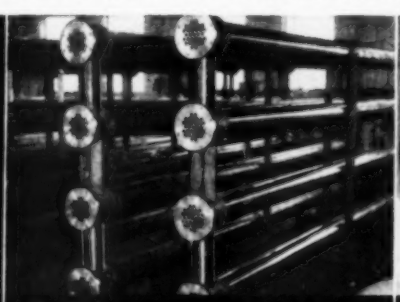
High efficiency in the causticizing department of a new cellulose plant erected by one of the largest concerns in the country is achieved by these ADSCO Heat Exchangers. In the process, one liquid must be cooled, the other heated. The ADSCO exchanger thus accomplishes two jobs in one. To achieve the small terminal temperature differences desired, counterflow design, with the exchangers in series, was necessary. Straight-tube, fixed-tube-sheet construction was selected as the most economical design.

Liquid in the tubes passes from one tube bundle to another through the 180° elbows at the ends; liquid in the shells passes from shell to shell through the short vertical connecting pipes. Hot corrosive liquor holds no terror for these exchangers because tubes and tube sheets are of stainless steel . . . These 40 exchangers are evidence of the contribution which ADSCO can make to the sound engineering required in chemical and petroleum processing plants. . . . Your ADSCO representative invites inquiries.

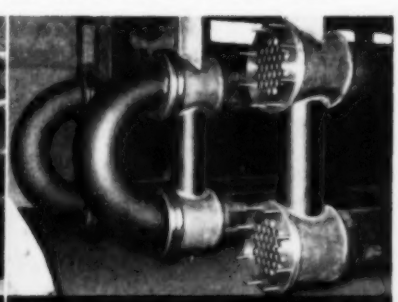
AMERICAN DISTRICT STEAM COMPANY, INC. NORTH TONAWANDA, NEW YORK

ADSCO ENGINEERED PRODUCTS FOR THE CHEMICAL, GAS AND OIL INDUSTRIES

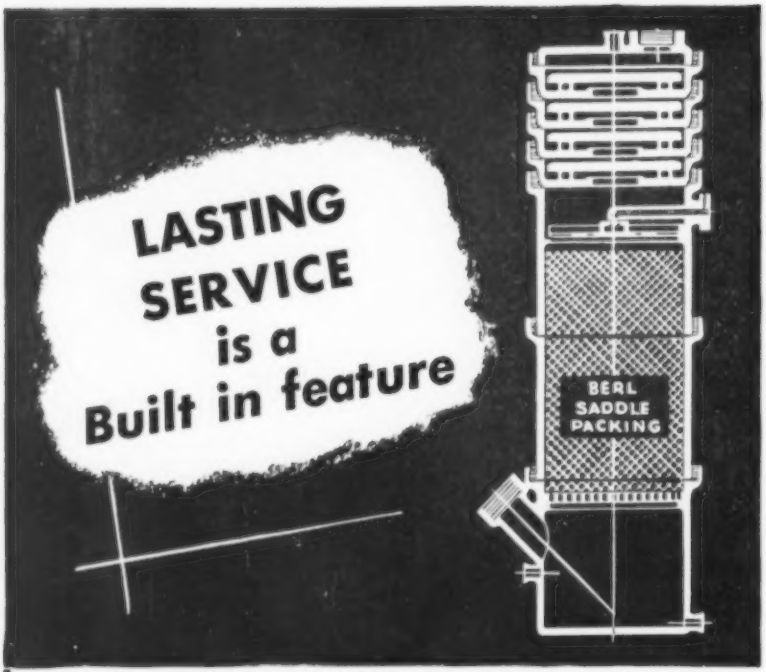
ADSCO is widely known for the high quality of its welding. Here, a workman is welding a support to shell of exchanger.



To eliminate stress while heat exchanger is in operation, tubes are roller expanded into tube sheets while unit is steam heated.



ASME construction throughout. Shell design pressure, 200 lbs.; test, 400 lbs. Tube design pressure, 150 lbs.; test, 300 lbs.



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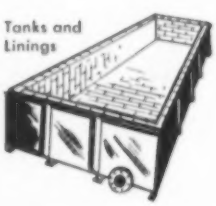
Separators, reactors, kettles, surge tanks



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From piping to complete plant, Knight can supply you with corrosion proof chemical equipment engineered and constructed to your specific requirements.

In each case, our engineering department first checks function and service conditions in order to select the most suitable materials. These may include Knight developed materials such as Knight-Ware, Permanite, Pyroflex, Sealon, or any others which are best suited to the particular job. Thus each unit is custom engineered to give lasting service under toughest corrosive conditions.

To make the package complete, Knight also supplies tower packings from the widest selection available, as well as special corrosion-proof cements and coatings.

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Maurice A. Knight 8211 Kelly Ave., Akron 6, Ohio

Acid and Alkali-proof Chemical Equipment

What's **Happening** . . .

plant manager of the new refinery at Yorktown. He joined Pan American in 1937.

U.S. Rubber Announces Election Of Caskey as Vice President

United States Rubber Company has announced the election of John E. Caskey as a vice president of the company and general manager of its Naugatuck Chemical division. Caskey succeeds vice president John P. Coe, who has been named to handle the company's interests in the transfer of synthetic rubber plants from the government.

Caskey

At the time of his election, Caskey announced that George R. Vila, formerly general sales manager of the division, will become assistant general manager. Caskey, together with Vila, will direct all sales, research and production activities of Naugatuck Chemical division.

McNamee Gets New Assignment At Union Carbide and Carbon

Raymond W. McNamee has been appointed manager of research administration of Union Carbide and Carbon Corporation. He will help coordinate the research activities of all the corporation laboratories where basic research and development is being done on alloys, chemicals, gases, carbons and plastics.

Dr. McNamee joined the corporation's chemical research organization at South Charleston, W. Va., in 1933, and, since 1950, has been superintendent of the Research and Development department of Carbide and Carbon Chemicals Company, a division of Union Carbide. Dr. McNamee was this year's winner of the ACS Herty Medal.

Franklin Johnston, who joined the corporation in 1933, succeeds McNamee as superintendent of the Research and Development department. He has been assistant director of research for the company since 1951.

General Petroleum Elevates Collier to New Refinery Post

Linden G. Collier has been advanced to shift foreman at General Petroleum Corporation's Torrance, Calif., refinery. He had been asphalt plant foreman at the company's Vernon, Calif., refinery since 1948.

Collier's oil company service dates back to 1923 when he was employed by the Gilmore Oil Company, which was consolidated with General Petroleum in 1946.

Klein Joins Mechanical Design

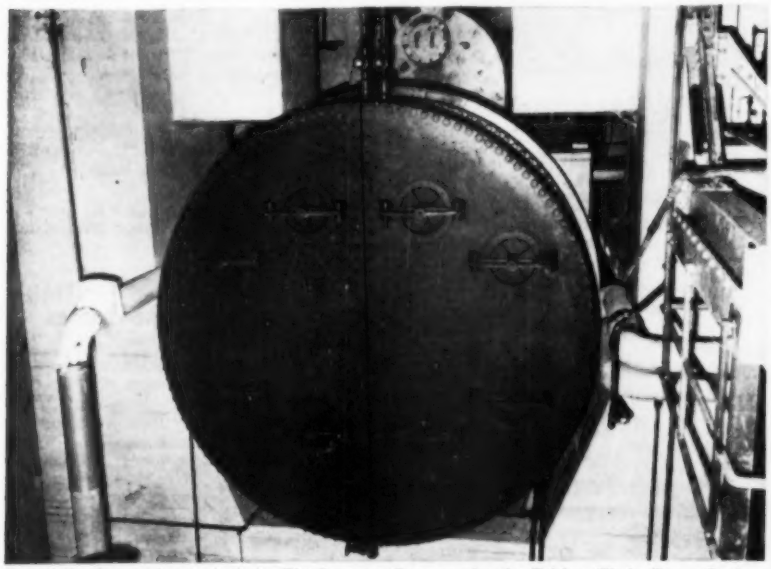
George F. Klein, Jr., has become chief engineer for Mechanical Design, Inc., affiliate of Refinery Engineering Company. He formerly was with Spencer Chemical Company, where he was chief engineer. He has also had experience

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



One of the five condensers built by The Lummus Company for the Fairless Works Power Station, United States Steel Corporation, Morrisville, Pennsylvania.

New Fairless Works Power Station Has 60,000 KW Capacity

On a 3,900 acre tract on the bend of the Delaware River south of Trenton, stands the largest integrated steel plant ever built at one time—the great new Fairless Works of United States Steel Corporation.

Among the main features of this vast operation are two blast furnaces, nine open hearth furnaces, two batteries of 87 coke ovens each, slabbing, blooming, rolling and tin plate lines. To serve the mill, there are 75 miles of standard railroad track, 20 miles of roads, 30 miles of sewers, a water-treating plant of 254 million gallons daily capacity, and a power station with a 60,000 kw output.

Power Station Equipment

The Fairless Works Power Station uses two turbo-generators, each rated at 30,000 kw to supply its power needs. One generator was built by General Electric, the other by Allis-Chalmers. In addition to the two turbo-generators there are three Ingersoll-Rand blast furnace turbo-blowers, each having a capacity of 110,000 cfm standard air (30" of mercury/60° F) at 35 psig discharge pressure.

The five surface condensers which serve both the generators and blowers were built by The Lummus Company.

Design Features of Condensers

Condensers are all of the two-pass, divided flow type. Those serving the turbo-generators each have condensing surfaces of 25,000 sq. ft. Each unit can condense 260,000 pounds of steam per hour (247,000,000 BTU/hr.) at 27.25" of mercury vacuum when supplied with 25,400 gpm of cooling water. Each of these condensers is fitted with 4,590 arsenical Admiralty tubes supplied by Bridgeport. The tubes are 18BWG, 7/8 inch in diameter and 24 feet in length.

The three condensers serving the turbo-blowers each have condensing surfaces of 10,400 square feet. Steam is condensed at the rate of 108,000 pounds per hour (102,800,000 BTU /hr.) at 27.25" of mercury vacuum for each unit. Water circulates at the rate of 11,000 gpm. Tubes are of Bridgeport's arsenical Admiralty—2,204 tubes per condenser. Tube dimensions are 18BWG, 7/8 inch diameter, and 20 feet 10 1/8 inches in length. In all five condensers the cooling water velocity is 6.75 feet per second. Water is drawn from the Delaware and chlorinated before use. Thus far, no trouble has been encountered with the river water.

Choice of Proper Tubing Vital

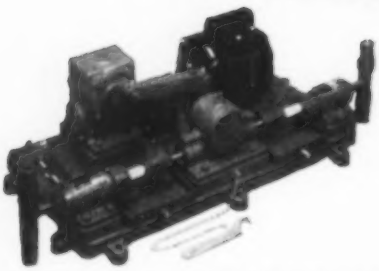
Depending on operating conditions and equipment design, the proper choice of condenser tubes plays an important part in the over-all efficiency of a power installation. The Fairless Works Power Station utilizes water from the river that is affected by brackish tides and is somewhat polluted by factory wastes. Under these conditions, arsenical Admiralty is a good choice, especially when the water is chlorinated, for mild chlorination combats slime deposits without attacking the alloy. And, since it contains arsenic which acts as an inhibitor, arsenical Admiralty resists dezincification.

Bridgeport Corrosion Laboratory

If you have any problems relating to condenser tubes—from choice of proper tubing to corrosion, fouling or cleaning — Bridgeport Corrosion Laboratory will be glad to work with you. Call the Bridgeport district office nearest you for your condenser tube requirements. Meanwhile, write on company stationery for your copy of the 156-page "Bridgeport Condenser and Heat Exchanger Tube Manual." It is a complete guide to the many types of tubes in use under all varieties of operating conditions. It contains much helpful information on combating corrosion problems. Heat transfer, weight, and dimension tables are also included. Send for your copy today. (643)

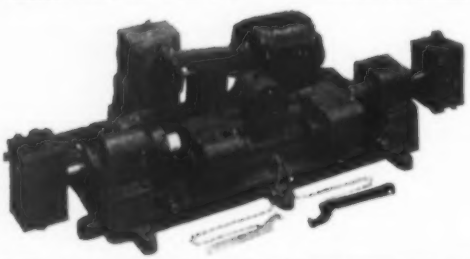
If you meter or proportion small volume flows...

THERE IS A HILLS-McCANNA "U" TYPE PUMP TO DO THE JOB



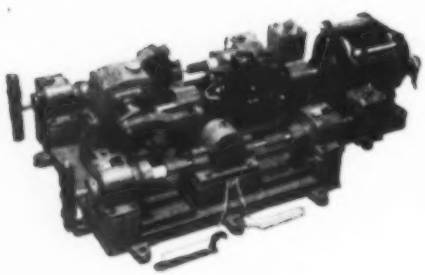
STANDARD 1, 2, 3 or 4 FEED UNITS

Standard "U" Pumps are available in maximum capacities from 0.10 to 24.0 gal. per hr. per feed. Operating pressures from 125 to 5000 psi.



JACKETED UNITS

For handling materials that require heat or refrigeration, "U" Pumps can be supplied with either or both jacketed liquid ends and check valves.



VARIABLE SPEED UNITS

"U" Pumps can be furnished with a variable speed drive which permits varying capacity remotely or automatically when combined with the proper auxiliary equipment.

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What's **Happening** . . .

with Hercules Powder Company, Allied Chemical and Dye Corporation and Procter and Gamble Manufacturing Company.

Vice President and Directors Appointed by Grace Chemical

Elwyn E. Winne, formerly an assistant vice president of both W. R. Grace & Company and Grace Chemical Company, has been elected a vice president and a director of Grace Chemical. At the same time William A. Thurston, president of Thurston Chemical and Naco Fertilizer Company, and John T. Whitely, an assistant vice president of W. R. Grace & Company, have been elected directors of Grace Chemical.

Winne has been with the Grace organization since 1948. Thurston has been president of Thurston Chemical, which he formed, since 1944. Whitely joined the Statistical department of W. R. Grace & Company in 1949, was made an assistant vice president in 1951.

UOP Sponsors Two Scholarships At Colorado School of Mines

Two scholarships worth $250 each will be awarded for the second semester to two senior students in petroleum refining engineering at the Colorado School of Mines. Sponsor of the scholarships is the Universal Oil Products Company.

The awards will be made in consideration of proficiency in engineering studies; leadership, willingness, cooperativeness, initiative, and ambition; ability to direct and stimulate others; and good health and physique.

Professor James O. Ball, head of the Mines Petroleum Refining department, will obtain applications for the UOP scholarships from senior students in the department and make recommendations to the Faculty Scholarship Committee.

Pemex Making Plans to Quit Arbol Grande Refinery

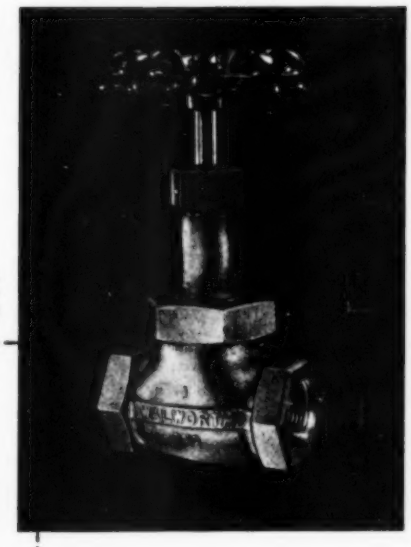
Plans are being formulated by Petroleos Mexicanos for the abandonment of the Arbol Grande refinery near Tampico at an early date. The refinery, which has a capacity of 23,000 barrels a day in crude charge and 14,500 barrels a day in thermal cracking, is believed to be the first established in Mexico with U. S. capital.

A spokesman for Pemex said that the equipment would be dismantled, and the workers shifted to more profitable plants. The refinery has facilities for lubricating oil, asphalt, and wax manufacture, but the plant equipment is reported to be old and outmoded.

Carroll, Humble Comptroller, Retires After Long Service

Gay Carroll, comptroller of Humble Oil & Refining Company since 1940, has retired because of his health. He has been succeeded by O. L. Luper, assistant comptroller.

Carroll's voluntary retirement comes after more than 35 years service with the Humble Company. He started in 1918 as a price clerk in the Warehouse department and was elected comptroller in September 1940 to succeed L. H. Attwell, who had retired.



take a good look at the Walworth "500 Brinell" no. 225P Globe

IDENTIFICATION DISC: An aluminum marking plate on all Walworth No. 225P's facilitates inventory control and makes reordering quick and positive.

NEWLY DESIGNED HANDWHEEL: Patented air-cooled, finger-fit handwheel affords sure grip even with greasy gloves.

IMPROVED PACKING: Molded packing of lubricated asbestos reinforced with copper wire. Suitable for practically every service. Valves can be repacked under pressure when fully opened.

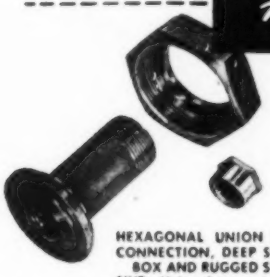
– the Toughest Bronze Valve Your Money Can Buy

The stainless steel, corrosion resistant seats and discs are heat treated to a hardness of 500 Brinell – hard enough to scratch glass and crush nails! The valve can be closed on sand, slag, and pipe scale without injury to the seating surfaces. "Wire drawing" is practically eliminated. All parts are accurately machined and gaged. Years of tight, positive shut-off are assured.

Available in both globe and angle types (angle type: No. 227P) in sizes ¼" to 2", this quality valve is recommended for 350 lbs. W.S.P. at 550 F, and 1000 lbs. non-shock service on cold water, oil, gas, or air.

For full data on this long-life, economical Walworth Bronze Valve, see your local Walworth distributor, or write for Circular.

note these 7 Great Features



HEXAGONAL UNION BONNET CONNECTION, DEEP STUFFING BOX AND RUGGED STUFFING NUT: Union bonnet connection eliminates any chance of distortion or leakage even though valve is repeatedly taken apart and reassembled.

OVERSIZE STEM: The high-tensile strength silicon-bronze stem assures long life and protection against wear.

SEATS AND DISCS: Plug type seats and discs of stainless steel, heat-treated to 500 Brinell hardness and machined simultaneously to a mirror-like finish, with accurate tapers assures tight positive shut-off with minimum handwheel effort.

EXTRA STRONG BODY: Made of Composition M (ASTM B61) bronze. Thick walls and rugged hexes provide a high safety factor. Valves undergo hydrostatic shell test of 1,000 psi.

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Who's **Meeting** . . .

Award-winning William G. Domask (right) receives congratulations for his paper from John J. McKetta (center), Editorial Director of Petroleum REFINER. Co-author of the paper is Dr. Kenneth A. Kobe. The paper appeared in Petroleum REFINER in the March, May and July issues last year. See accompanying account of preceedings.

AIChE

The South Texas Section of the American Institute of Chemical Engineers climaxed its annual meeting October 16 in Galveston, Texas, with the presentation of the award for the best technical paper written by one of its members to Dr. William G. Domask and Dr. Kenneth A. Kobe, University of Texas. The winning paper was the series "Extractive Crystallization," published in the March, May and July, 1952 issues of PETROLEUM REFINER. Dr. Domask is presently employed in the Technical Service division of the Humble Oil & Refining Company, Baytown, Texas.

The all-day technical session included a symposium on industrial organic chemicals and one on economics and cost estimating (PETROLEUM REFINER, October, 1953).

Demineralizing Water

In the general session W. E. Katz and T. A. Kirkham discussed the promise of an electric membrane demineralization process for treating brackish waters. The brackish water range considered in the paper was defined as 1000 to 10,000 ppm of total ionized solids, and some data were given on the occurrence of such waters in the world and on typical analyses of such waters in various U. S. cities. The basic principle of electric membrane demineralization was described. Comparisons were presented between the basic fuel costs necessary for vapor compression distillation and the electric membrane method as well as the basic chemical costs for chemically regenerated ion exchange. The fuel cost for the process was calculated assuming a reasonable efficiency for a diesel or steam electric plant. Fixed charges, labor, maintenance, and water costs were excluded from all calculations. Performance data on a packaged brackish water demineralizer based on the process were presented as an example of presently-available equipment.

Engineers into Executives

Dr. Robert F. Pease pointed out the great need for executives with engineering backgrounds in industry today has led to much activity in the field of appraising and developing engineers for executive positions. Preliminary studies indicate that in some firms, only about one out of three engineers has the long range potentials for development to top jobs.

Engineers, as well as other technical specialists, are being evaluated for such potential through the medium of projective personality techniques which reveal personality patterns making for success in top executive positions. In general, engineers have certain qualities which tend to impede their success in executive positions, just as do other occupational groups. By evaluating these qualities through projective techniques, it is possible to point out areas that can be strengthened through development.

Technical Personnel Training

In the student session, J. T. Moody explained the training program which the Technical and Research division of the Humble Oil and Refining Company provides for its chemical engineers. Although the new engineer is being trained for the moment he is employed, his formal training begins with the Practice School. The Practice School is intended to bridge the gap between classroom and industry so that the new engineer can become productive in the shortest possible time. The school is normally of about three months' duration and is the only duty of the engineer for that period. The curricula includes an intensive chemical engineering course consisting of both review and advanced material. Application to petroleum refining is stressed, and the refining processes and operations at the Baytown Refinery are thoroughly studied. Practical problems and plant tests are included. In addition, organization and policies of the Humble Company and professional development are discussed during the school.

Humble lectures in Science are another major phase of the training program. Well-known professors come to Baytown to present a two- or three-weeks' full-time course in their respective major fields to a selected group of engineers.

WPRA

In its Regional meeting in El Dorado, October 22-23, the Western Petroleum Refiners Association devoted the technical session to a panel discussion of forty-five operating questions. The questions were answered by a group of refinery and engineering experts. The main interest centered on the question concerning CO/CO_2 ratio in catalytic cracking standpipe design and refractory and gunnite lining.

Dave Reed of Universal Oil Products Company related pilot plant findings with respect to the CO/CO_2 ratio. The conclusions were that an increase in air space velocity from 2 to 8 decreases the ratio from 2 to 1. The metal content of the feed raises the ratio, and the specific gravity and boiling point of the feed stock have no effect on the ratio.

C. O. Brown, American Cyanamid Company, discussed the effect of iron in the feed stock and in natural catalyst. The oxidation rate increases with the amount of iron.

E. C. Tinsley, Mexico Refractories Company, advised against the use of castables on brick linings in catalytic cracking regenerators. Dr. N. K. Anderson of the Deep Rock Oil Corporation related the experience of his company in regard to the spalling of gunite linings.

Five-Day Turnaround

A turnaround in five days every two years on a cat cracker was described by A. D. Fischbeck, Phillips Petroleum Company, as common practice in his company. He stated that the success of such fast turnarounds is based on a well-planned operation with each crew well trained in its particular work.

E. A. Heike, Premier Petroleum Company, acted as panel moderator. Other members of the panel were W. M. Carney, Lion Oil Company, H. K. Wheeler, Pan-Am Southern, and D. B. Ardern, Houdry Process Corporation.

CNGA

The annual fall meeting of the California Natural Gasoline Association, Los Angeles, October 8-9, was highlighted by three symposia on current problems in the natural gasoline industry. In the symposium on gas dehydration, J. A. Gordon, Union Oil Company, presented some of the more common operating and design problems confronting the gas

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A tremendous variety of fluid mixing needs are ably handled by the complete line of Eastern Mixers. Size and power of mixers are flexible to help solve your problems. For complete information and engineering data, write for Eastern Fluid Mixing Catalogs. Eastern engineers are always available to work out your complex mixing problems with you.

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Turbine Mixer

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Side Entering Mixer

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Who's Meeting . . .

dehydration plant operator. Starting with gas hydrates, he pointed out some of their physical properties and outlined briefly the more common methods of freeing frozen lines. A typical flow diagram of a diethylene glycol plant was given. He pointed out the tendency to dehydrate beyond the required range with subsequent deterioration of glycol and equipment. The main portion of the paper was devoted to a discussion of problems directly connected with the plant plant operation. Methods of keeping the glycol free of contaminants by the use of scrubbers, vent tank and filters were discussed. General problems related to the individual pieces of equipment such as pumps, rectifiers, reboiler were pointed out. Fire hazards and glycol losses were discussed with emphasis on the experience of the operator as being all important in the handling of most operating and maintenance problems.

Vapor Phase Cooling

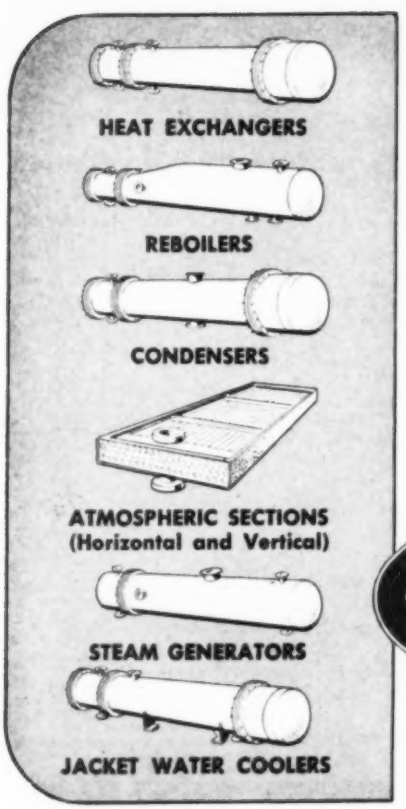
In the symposium on boiling point cooling systems, Monte E. Stone, Long Beach Oil Development Company, summed up the following conclusions, based on the experience of his company with three new compressor units using the recently developed vapor phase cooling system in place of the conventional forced water system:

- The vapor phase cooling system has been trouble free, except for the leaking head gaskets.
- External temperatures have not created any mechanical or operational problems.
- Flow measurement has shown a circulation rate of .2 gpm per B.H.P. at 67 percent of rated hp output.
- Soluble oil leaves a film of oil inside the cylinder jackets and should be used where practicable, if not determined to be harmful to the gaskets.
- Judging from the performance of this plant only, vapor phase cooling has definitely good possibilities for a place in industry.

Corrosion

The CNGA committee on corrosion sent out a questionnaire to the various operating companies in California to obtain information relative to corrosion experience in their plants. Reporting on this questionnaire, C. J. Smith, Western Gulf Oil Company, stated that the information received was not sufficiently complete to offer any satisfactory correlation. The fact that most operators have not kept complete records of corrosion history of a particular system, or the costs resulting from corrosion, made the questionnaires extremely difficult to prepare with any degree of accuracy. Since there is no accepted standard of comparison, judging the degree of corrosion is also difficult. Probably in most cases replacements have been made as required with no investigation into the cause or the extent. A remarkable example indicating the lack of knowledge was brought out by the questionnaire. A line reported to have slight to no corrosion failed within six months due to internal corrosion. As a first step in solving this problem, a program for keeping accurate records of corrosion losses, replacement costs and treating costs has been instigated by the committee.

Continued on page 236.



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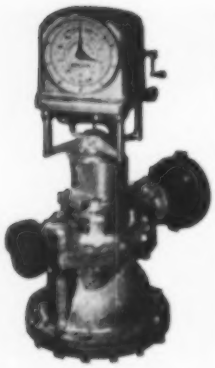

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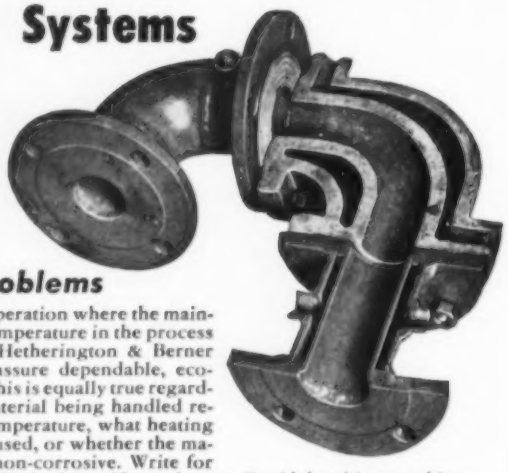

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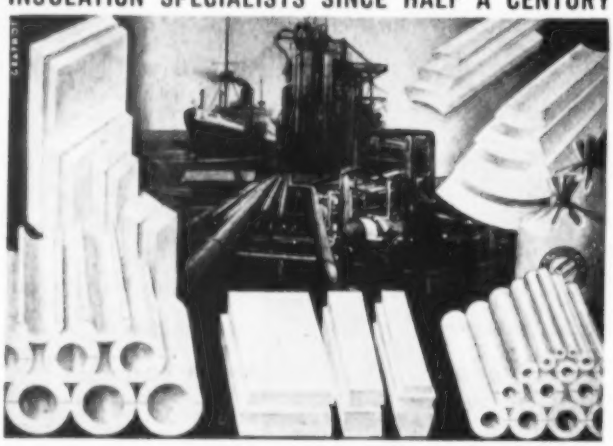

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Who's Meeting . . .

Refrigeration Units

D. F. McFaddin, Union Oil Company, compared the extraction efficiency, capital expenditures, and payout for two low temperature extraction plants with a conventional absorption type plant. Experience gained from the construction and operation of two small refrigeration type condensate extraction plants in California indicates that they deserve careful consid-

IN THE FUTURE

NOV.	
9–12	American Petroleum Institute (33rd Annual Meeting), Conrad Hilton Hotel and Palmer House, Chicago.
16–17	Packaging Institute (Petroleum Packaging Committee), New York.
19–20	Third Annual Instrument Short Course, Los Angeles Harbor Junior College, Wilmington, Calif.
19–20	National Association of Corrosion Engineers (Western Region), Los Angeles.
20	Natural Gasoline Association (Panhandle Plains Regional Meeting), Herring Hotel, Amarillo, Texas.
29 to Dec. 4	American Society of Mechanical Engineers (Annual Meeting), Statler Hotel, New York.
DEC.	
7– 9	Oil Industry Information Committee, Waldorf-Astoria, New York.
13–16	American Institute of Chemical Engineers (Annual Meeting), Jefferson Hotel, St. Louis.
JAN. 1954	
11–15	Society of Automotive Engineers (Annual Meeting and Engineering Display) Sheraton-Cadillac and Statler Hotels, Chicago.
18–22	American Institute of Electrical Engineers (Winter General Meeting), Statler Hotel, New York.
FEB.	
15–17	American Petroleum Institute (Lubrication Committee), Sheraton-Cadillac Hotel, Detroit.
23–24	Packaging Institute (Petroleum Packaging Committee), Houston.
26	Natural Gasoline Association of America (Permian Basin Regional Meeting), Lincoln Hotel, Odessa, Texas.
MAR.	
1– 5	American Society for Testing Materials (Spring Meeting), Shoreham Hotel, Washington, D.C.
8–10	American Institute of Chemical Engineer, Statler Hotel, Washington, D.C.
15–19	National Association of Corrosion Engineers (Tenth Annual Conference), Municipal Auditorium, Kansas City, Mo.
25	National Industrial Conference Board, Ambassador Hotel, Los Angeles.
APRIL	
5– 7	American Society of Lubrication Engineers, Netherland-Plaza Hotel, Cincinnati.
14–16	National Petroleum Association (51st Semi-Annual Meeting), Cleveland Hotel, Cleveland.
21–23	Natural Gasoline Association of American (33rd Annual Convention), Baker Hotel, Dallas, Texas.
MAY	
3– 5	American Petroleum Institute (Lubrication Committee) Skytop Lodge, Skytop, Pa.
3– 7	American Petroleum Institute (Safety & Fire Protection Committees, Midyear Meeting), Chase-Park Plaza, St. Louis.
9–12	Liquefied Petroleum Gas Association (Annual Convention), Conrad Hilton Hotel, Chicago., Ill
10–13	American Petroleum Institute (Division of Refining, Midyear Meeting), Rice Hotel, Houston.
16–19	American Institute of Chemical Engineers, Springfield, Mass.
17–21	National Fire Protection Association, (58th Annual Meeting), Statler Hotel, Washington, D.C.
20–21	National Industrial Conference Board (38th Annual Meeting), Waldorf-Astoria, New York.

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Who's Meeting . . .

eration as a low investment means of processing natural gas obtaining a reduced extraction of liquid components. The successful application depends upon proper engineering, taking into consideration the composition of the gas as well as the relative values of the light and heavy components of the condensate produced. On the other hand, conventional type absorption plants appear still to be the answer for California's natural gas when higher extraction efficiency is justified.

Ammonia from Natural Gas

F. D. Kuenzly, Shell Chemical Company, explained in his paper the role of natural gas in the synthetic ammonia industry. The importance of ammonia in our economy was pointed out in discussing the properties and uses of ammonia. The historical background indicated the problems to be overcome in the development of the synthetic ammonia process and reviewed the growth of the industry. In covering the raw materials and processes used, the advantages of natural gas over coke were pointed out to explain the spectacular growth in the use of natural gas in the synthetic ammonia industry.

Swearingen Sets Up Award for Staff of Southwest Research

An annual award to a member of the staff of Southwest Research Institute for outstanding research achievement has been established by Dr. Judson S. Swearingen, a consultant to the institute. Dr. Harold Vagtborg, institute president, accepted the non-commercial award from Dr. Swearingen on behalf of the research laboratories. Vagtborg said that the first of the awards will be presented late this fall in a public ceremony before some of the nation's "leading scientists, industrialists and educators when they, as institute directors and trustees, attend our annual meeting."

Swearingen, a scientist himself, was formerly an oil refiner and once was a professor of chemical engineering at the University of Texas. With nine others, he was cited for his contributions to the development of the K-25 plant at Oak Ridge, Tenn.

Only full-time staff members below the institute level of the department chairman will be eligible for the award, with the winner becoming ineligible for the four succeeding years, it was reported. The award will consist of $100 cash and a certificate.

Southwest Research Institute Adds George L. Cunningham

Dr. George L. Cunningham, well-known industrial scientist and research executive, has been appointed to the staff of Southwest Research Institute. Inventor and holder of many patents, Dr. Cunningham will head a group of technologists at the research center working towards the "advancement of the science and technology of inorganic chemistry and inorganic chemical manufacturing."

Dr. Cunningham was formerly associated with the applied science laboratory of the University of Cincinnati. Earlier he had been manager of technical

service for the Columbia Chemical division of Pittsburgh Plate Glass Company; assistant and acting director of research for Diamond Alkali and Dye Corporation, and technical director for Commonwealth Engineering Company.

New API Committee Will Study Causes of Evaporation Losses

A new committee to study losses of petroleum liquids by evaporation has been appointed by President Frank M. Porter, of the American Petroleum Institute. J. H. McClintock, of Esso Standard Oil Company, was named chairman.

The group is to be known formally as the Committee on Evaporation Loss. The specific scope of its activities will be "the development of factors governing the evaporation loss of petroleum liquids for use in the solution of operating problems."

Membership of the committee, in addition to McClintock, follows:

J. H. Brown, Tide Water Associated Oil Company; W. H. Creel, Phillips Petroleum Company; P. E. Frank, Sinclair Refining Company; H. M. Hart, Standard Oil Company (Indiana); R. W. Hill, Stanolind Oil & Gas Company; E. L. Hoffman, Socony-Vacuum Oil Company; F. P. Irwin, Imperial Oil Company, Ltd.; O. W. Johnson, Standard Oil Company of California; K. G. Krech, The Atlantic Refining Company; H. S. Mount, Sun Oil Company; H. C. Packard, Shell Oil Company; E. O. Perkins, The Texas Company; G. B. Ryan, The Standard Oil Company (Ohio); A. B. Stevens, General Petroleum Company; L. S. Wrightsman, Humble Pipe Line Company; E. O. Mattocks, American Petroleum Institute, (secretary).

At an organizational meeting in St. Louis, the new committee set up four operating sub-committees, as follows:

1. Method of Testing, H. M. Hart, chairman;
2. Correlations, A. B. Stevens, chairman;
3. Test Program Development, H. C. Packard, Chairman;
4. Program and Publications, W. L. Hoffman, chairman.

The sub-committees were to have made their first report to the full committee at the 33rd annual API meeting.

Lubricating Grease Institute Honors Farrington with Award

Bruce B. Farrington, California Research Corporation, has been named recipient of the National Lubricating Grease Institute's first Annual Award for outstanding contribution to the lubricating grease industry.

Farrington, administrative assistant to the manager of petroleum products research at Cal Research, subsidiary of Standard Oil Company of California, was honored for his electron microscope investigations into the real structure of lubricating grease.

Miller Named Plant Engineer

Ferril M. Miller has been named resident plant engineer for Cities Service Oil Company's Chicago terminal and compound plant. As resident plant engineer, Miller also will head the technical service department of the plant.

Roy Petterson will succeed Miller as resident chemist at the plant's laboratory.

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What's New in Manufacturers' Literature

For copies of the catalogs and new equipment literature listed, use one of the convenient Reader Service Postcards on this page. Just circle the number on the card corresponding to the number of the item in which you are interested.

Tubing Data Card

The new data card issued by the Tubular Products Division of The Babcock & Wilcox Company is prepared specifically to aid individuals in the design and operation of tubular equipment at high temperatures and pressures. This card, an adaptation of Table P-7 of the new ASME Boiler Code, is complete with notes and formulas for the calculation of the maximum allowable working pressures for tubing and pipe as well as a tabulation of the S values (maximum allowable stress values) of a complete range of seamless and welded carbon, alloy and stainless steel pipe and tubing. Get your free copy of this helpful card now.

Circle No. 1 on Postcard

Weldments

Weldments are the subject of a new 16-page bulletin issued by Struthers Wells Corporation. The brochure considers the advantages of using steel weldments, outlines the company's qualifications for weldment manufacture and indicates some of the production facilities available in Struthers Wells' three plants. The bulletin also presents definitions concerning weldments, explains comparative properties and advantages of steel versus cast iron, and gives general data showing weldability of ferrous metals.

Circle No. 2 on Postcard

Relief Valves

A new 24-page booklet, "Selection and Sizing Pressure Relief Valves to Comply With ASME Boiler Code Requirements," has been published as a contribution to industry by McDonnell & Miller, Inc. While the ASME Code is explicit about the capacity ratings of relief valves to match the gross heat output of the equipment, no guide procedure is readily available for determining the gross heat outputs.

For your copy, just . . .

Circle No. 3 on Postcard

Mechanical Seals

A 20-minute, full color film on mechanical shaft seals for centrifugal pumps is now available through Byron Jackson Company. This film covers mechanical seals from design to maintenance and should be of interest both to engineering and to maintenance personnel. Various types of seals and their applications are described. Seal operation is graphically illustrated by animated drawings. For more information, simply . . .

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MAIL IT NOW . . . *CARD EXPIRES FEBRUARY 10, 1954

What's New in Manufacturers' Literature

Use one of the free and convenient Reader Service Postcards on this page to request copies of the catalogs in which you are interested.

Temperature Control

Burling Instrument Company's line of temperature controls is described in Bulletin 101, the first of a new series. This bulletin covers the Models H-1S and V-1S which are primarily used for high temperature safety alarms and cut-outs up to 1800 F. Included is complete information on operation, dimensions, methods of mounting, and operating specifications. Both units described in the bulletin operate by differential expansions of solids, use snap-action switch rated at 15 amperes, 125-250 volts, 60 cycles and can be obtained with a wide variety of standard and special tubes.

Circle No. 5 on Postcard

Welding Nickel Alloys

A study of the various welding techniques, including some of the newer inert gas processes, electrodes, preheat treatments and postheat treatments, is being offered in a new bulletin by The International Nickel Company. This 44-page bulletin, with tables, graphs, and illustrations, gives typical results that can be expected for the low alloy high strength steels as well as low carbon, medium carbon engineering alloys, and special steels. To get this informative bulletin, just . . .

Circle No. 6 on Postcard

Stuffing Box Design

Sawyer-Jensen-Ross Company's new stuffing box design for SJR Shortstir Mixers features a mechanical seal and self-lubricating shaft bushing. According to the manufacturer, the new stuffing box design was developed with the help of refinery and pipe line operators to eliminate the standard "packed type" stuffing box which frequently leaks while in service and requires a special lubricator.

The new mechanical seal and self-lubricating shaft bushing stuffing box will be standard on all Shortstir Mixers produced by the company in the future. It has been designed for easy field conversion on mixers now in service.

Circle No. 7 on Postcard

ph Control

Milton Roy Company is now reissuing a technical bulletin on "Automatic pH Control in Water and Industrial Waste Treatment." Illustrated both by photographs and diagrams, this bulletin covers several typical systems of automatic pH control in boiler feed water treatment. Described in the paper are the uses of air and motor operated valves as well as controlled volume pumps to effect proper addition of treating chemicals. Some of the pitfalls encountered in this type of control are brought forward and discussed. Copies of this informative bulletin are available now. Just . . .

Circle No. 8 on Postcard

Refractory Products

Features, characteristics and specifications of Plibrico refractory products are listed in Plibrico Company's new catalog, "Plibrico Refractory Products for the Oil Industry." The 16-page booklet describes the company's refractory products for: horizontal heaters; vertical heaters; catalyst regenerators; transfer systems; and vapor separators.

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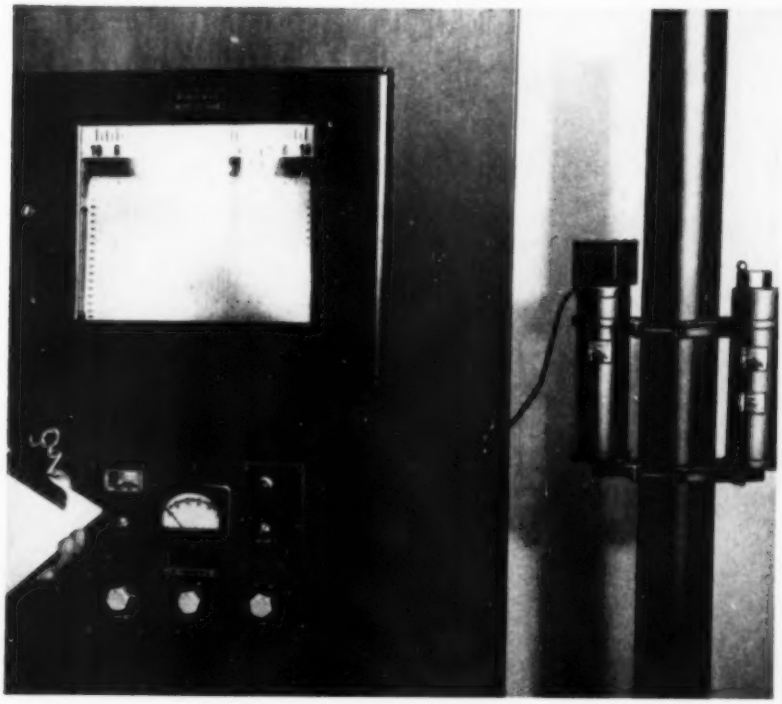


Specific Gravity Meter

Use of radioactive source plus an ingenious measuring cell makes possible an instrument featuring:

- **High stability**
- **Low maintenance**
- **Simple mounting**

The Ohmart Company is making available to the refining and petrochemical industry a new level and density gage. Employing a new concept, the Ohmart cell features extreme simplicity, long service life, and, in most cases, measurements without the need for connections to the process piping or vessels.

How? The Ohmart cell consists of a gas filled chamber containing two electrodes of electrochemically dissimilar metals. Just as in the ordinary electrolytic cell these electrodes have a difference in potential between them, because of their electrochemical differences. When the cell is connected to a closed external circuit and is exposed to a radioactive source, a small current will flow. This is due to the potential difference between the electrodes and to the gas surrounding them being ionized. The amount of current that will flow depends on the amount of radioactive energy entering the cell. Since the source used is one of constant energy, the only change in energy, ionization, and ultimately current flowing in the cell, is due to the absorption by the material between the source and the cell. This absorption is a function of the density of this material. The seeming analogy between the Ohmart cell and the ordinary electrolytic cell is not a true one. In the case of the Ohmart cell, the dissimilar metal electrodes are not involved in any chemical reaction. All of the energy produced by this cell comes from the ionization of the gas by the radioactive source.

Where? The source and cell are usually mounted on opposite sides of the pipe or container holding the material to be measured. In the case of level controlling, the units are mounted at the desired level. These mountings are outside of the vessels or pipes in almost all cases. This feature, combined with the complete lack of dependence on external power supplies, and the ruggedness of the cell and source units, makes the Ohmart density gage a very low maintenance item.

Radiation Hazards? No! Unless the degree of accuracy required by the process can be obtained without hazard to health from radioactivity, the application will not be considered.

When? This device is new. The manufacturer advises that adequate laboratory facilities are available in his plant to make preliminary measurements relating to every new problem presented. Such preliminary tests of samples must be made for each new application. These tests are necessary in selection of the source, type of cell, and method of application. For complete information on this unique development, simply . . .

Circle No. 10 on Postcard

Acid Proof Surface

The Carboline Company announces a simplified method of acid proofing concrete floors, sumps, and foundations. This new product development, called Phenoline 300, is a modified phenolic resin, which may be applied by brush, spray, or trowel. The manufacturer lists the following as outstanding advantages of this product.

- Complete bonding to alkaline or neutral surfaces.
- No shrinkage in setting.
- Impervious to caustic soda and to most solvents, hot or cold.
- Surface preparation requirements simple, application quick and easy, curing time 8 to 24 hours.
- It can be applied on either old or new concrete.

This hard and wear resistant surfacing material should find numerous applications in the refining and petrochemical industries. To get the full story on Phenoline 300, simply

Circle No. 11 on Postcard

Reversible **Air Tools**

A new series of 24 lightweight, air operated, reversible screw drivers and nut setters has been announced by Thor Power Tool Company.

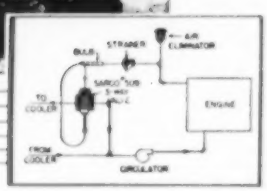
These latest additions feature reversible motors to permit the tool's use for

SARCO cooling controls

FOR DIESEL ENGINE JACKET WATER & OIL COOLERS...

Two 4" Sarco, type 23-509M Cooling Controls on Fairbanks-Morse Diesel engine at Seaford Light and Power Co., Seaford, Del.

Sarco type 23 Cooling Control with 3-way diversion valve No. 509M. Available also with 2-way piston valves, reverse or direct acting (by-pass control), in sizes ½" to 6".



Hook-up for engine jacket control using Sarco type 23 regulator with 3-way valve to recirculate a varying portion of the cooling water.

SARCO offers a complete line of self-operated Temperature Regulators for use on internal combustion engines for stationary, marine and locomotive application.

Their distinguishing feature is the use of

Liquid Expansion Thermostatic Systems . . .

In these systems, the thermostat bulb, connecting tubing and valve-closing element are completely filled with mineral oil.

Expansion of this oil, when heated, pushes forward a plunger in contact with the valve discs, thus positioning the valve.

Since the valves are double-seated and fully balanced, they can float on the line, providing gently throttling control.

The power for moving the valve is uniform per degree temperature rise at any point of the scale.

Sarco regulators are not limited to standard ranges. Each regulator is factory set for the exact operating temperature desired. It can then be adjusted by the user both higher and lower as required.

Sarco controls are built with packless seals eliminating the necessity of replacing packing from time to time.

Write for Sales Sheet No. S1429.

Sarco type 13W Air Eliminators prevent air pockets in water lines.

Sarco Pipe Line Strainer.

363

SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

SARCO CANADA LTD., TORONTO 8, ONTARIO

REPRESENTED IN PRINCIPAL CITIES

removing threaded fasteners as well as applying them, and for speeding inspection, testing, service, and repair of all assembled products.

The new reversibles are available in four basic speeds, ranging from 475 rpm to 2000 rpm. Each is offered with either slip clutch or positive clutch. A further option of lever or pistol type throttle is offered with all models.

Further information on these new tools is available through the reader service department. Just . . .

Circle No. 12 on Postcard

Safety-Relief **Valves**

J. E. Longeran Company claims its new "Longeran Uni-Line 41-W-200 Series" of safety-relief valves has several outstanding features not found on the more conventional safety-relief valves. These include:

- A much higher capacity per size than any other valve.
- A free-acting, self-aligning disc.
- A "floating" guide, readily adjustable for control, which assists in the opening and closing action.
- A disc and disc holder of forged copper alloy, not casting.

Available in sizes from 1½ through 6 inches, Longeran Uni-Line valves are V&W National Board approved. Advantages offered by the above "features" include: Reduction in size of boiler opening required to mount valve; reduction in shipping charges because of less weight; easier and more positive operations; and easy replacement or reconditioning of working parts.

Circle No. 13 on Postcard

Condenser **Tube** Kit

A new cleaning and application kit for combating a common failure in condenser tubes has been announced by Thomas C. Wilson, Inc. The kit, termed inexpensive, is designed to apply protection against costly inlet and erosion, which frequently cause a tube to fail

For Heavy Duty low cost operation

"International"

AGITATOR DRIVE HEADS AND TURBINES

WITH ECONOMY BELT DRIVE-INTERCHANGEABLE SPEEDS-FACTORY ASSEMBLED—ALIGNED-FOR OPEN OR CLOSED TANKS

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SOME *Current Desiqn* PROJECTS

- Recovery of Aromatics from Petroleum Stocks
- Methanol Refining
- Naphthalene Purification
- Recovery of Acetic Acid
- Ammonia Recovery
- Para Xylene Recovery
- Catalytic Polymerization (Gasoline)
- Ethyl Alcohol Refining

The variety of these projects indicates not only flexibility of engineering thinking but appreciation of new processing methods and how they can be adapted to new plants being built today and planned for tomorrow. We emphasize the importance of combining with experience an ever-fresh outlook on the processing picture as it unfolds from day to day.

Engineering

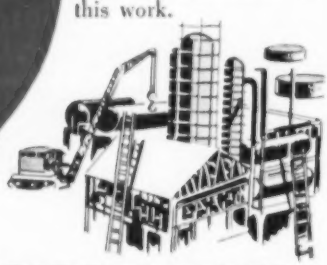
Design and Construction of Process Plants

Design and Construction of Process Units

Process Evaluations

Economic Studies

It is this combination of solid experience, flexibility of thinking and forward looking concepts that we would bring to *your* problem of plant or unit design. And, if you require process evaluation studies prior to design, we are staffed with competent engineers, experienced in this work.



BADGER MANUFACTURING COMPANY

230 BENT STREET, CAMBRIDGE 41, MASS. • 60 EAST 42nd STREET, NEW YORK 17, N.Y.

NEW Equipment . . .

within the first few inches of its length.

The manufacturer claims that this method of prolonging tube life insures removal of deposits, provides excellent protective adherence and makes certain that protective coating is spread evenly on the tube.

Circle No. 14 on Postcard

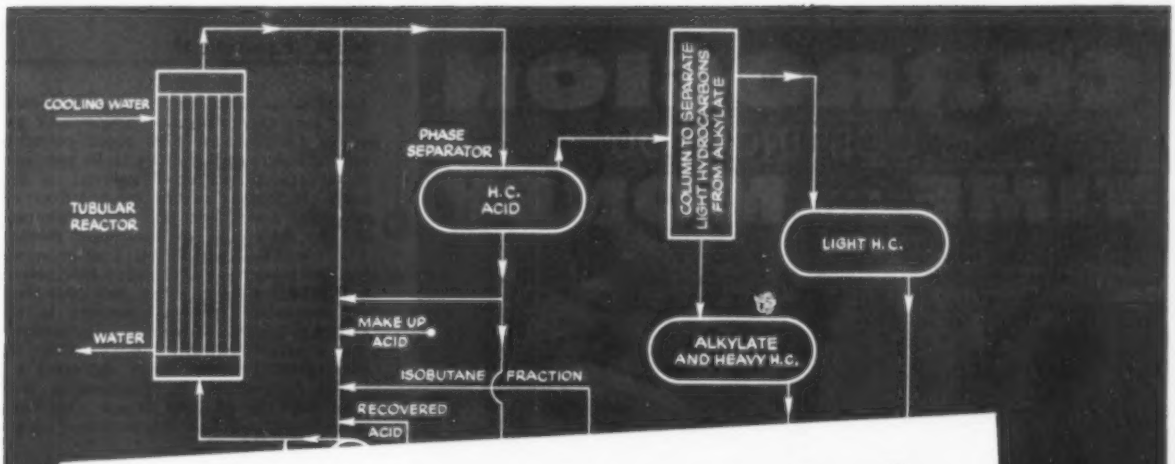
Safety Wrench

A new safety wrench has been developed by The Bergman Safety-Spanner Company to help rotate sticky hand wheels. Made of aluminum-magnesium alloy, it withstands pressures of over 500 pounds on the handle and 1200 pounds on the hook jaw. It operates efficiently at a 45 degree angle and fits 95 percent of all standard hand wheels. It weighs only 2 pounds, 13 ounces. It makes no sharp burrs on the wheel protecting the operator against cuts. Disengagement proof and spark proof, it guards against sprains, falls and fire hazards.

Circle No. 15 on Postcard

Integrator-Indicator

The Fischer-Porter Company has developed and is now announcing a new miniature integrator-indicator incorporating a full size integrating mechanism and standard five digit counter. The high



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ANHYDROUS HYDROFLUORIC ACID
SULFURIC ACID

☐ ***Polymerization***
FLUOSULFONIC ACID $HO{:}SO_2F$ (HSO_3F)
BORON TRIFLUORIDE
SULFURIC ACID

☐ ***Sulfonation***
SULFURIC ACID
SULFAN® (Stabilized Sulfuric Anhydride)
OLEUM

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MURIATIC ACID (Hydrochloric)

☐ ***Detergents & Builders***
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DISODIUM PHOSPHATE
SODIUM SULFATE, Anhydrous
TRISODIUM PHOSPHATE
TETRASODIUM PYROPHOSPHATE (TSPP)
SODIUM TRIPOLYPHOSPHATE

☐ ***Acidizing***
MURIATIC ACID (Hydrochloric)
HYDROFLUORIC ACID

☐ ***Mud Conditioning***
SODIUM SILICATE
DISODIUM PHOSPHATE
TRISODIUM PHOSPHATE
TETRASODIUM PYROPHOSPHATE (TSPP)
SODIUM TRIPOLYPHOSPHATE

☐ ***Grease Making***
ALUMINUM SULFATE

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SULFURIC ACID
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Aluminum Sulfate, Standard & Iron Free
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Allied Chemical

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IS COSTING YOU
TIME AND MONEY

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THIS NEW UOP CORROSION INHIBITOR —
WHICH IS SPECIALLY FORMULATED
FOR THE PETROLEUM REFINER

PREVENTS

COSTLY METAL LOSS AND
EXCESSIVE MAINTENANCE DUE TO
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IN CONDENSERS, TANKS,
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Let UOP engineers design and service a UNICOR system for your protection.

write for samples and literature.

UOP UNICOR

PRODUCTS DEPARTMENT
UNIVERSAL OIL PRODUCTS COMPANY
30 ALGONQUIN ROAD DES PLAINES, ILL., U.S.A.

NEW Equipment . . .

speed integrating unit senses and totals flow rate of the measured liquid or gas every 2.5 seconds. This rapid counting rate allows varying flows to be totalized to accuracies within 1 percent of full scale. It further makes the totalizer responsive enough to take full advantage of the sensitivity of flow rate meters. The totalizing mechanism is oil-immersed for permanent cleanliness, lubrication, and freedom from wear and corrosion. A particularly unusual feature is the heavy duty 100 RPM synchronous motor which establishes a timing base for the integrator. Its low speed increases the unit's ruggedness by eliminating delicate high speed gear trains. Get complete information on this new and unique device . . .

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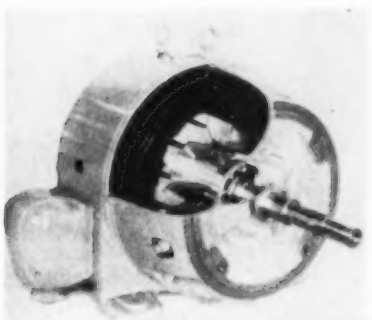


Centrifugal **Pump Motor**

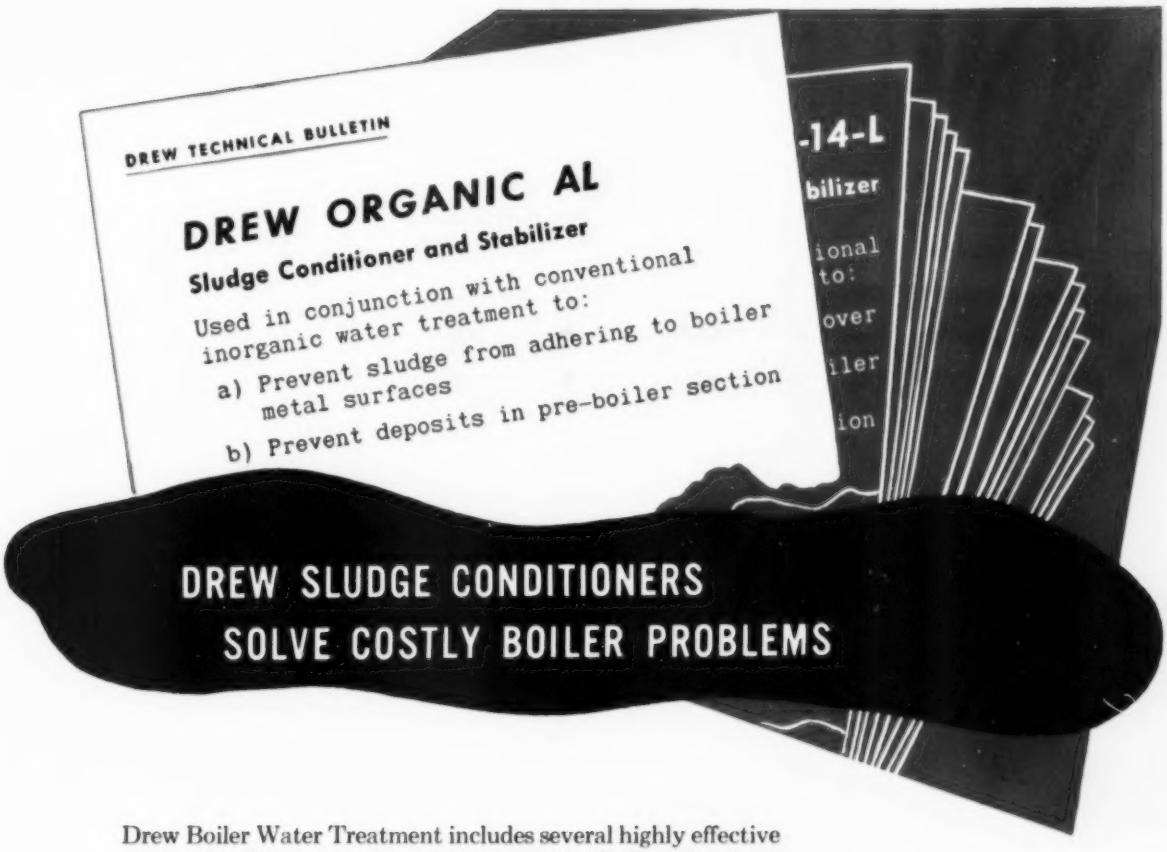
Close-coupled pump motors as high as 60 hp are now available through a recent development of U. S. Electrical Motors, Inc. Designed specifically for use with centrifugal pumps, this motor, type SCB, eliminates shaft alignment or pump mounting problems by supporting the pump on its NEMA style "C" registered mounting bracket. A step shaft, with special diameter, shoulder and tapped hole for mounting the impeller, has all ground diameters for precision assembly and sealing against leakage.

Grease lubricated ball bearings permit vertical, horizontal or any intermediate angle installation. Bearings are adequate to carry the thrust of centrifugal pumps. A solid, closed flange on the style "C" adapter bracket prevents entrance of the pumped liquid into the motor.

Circle No. 17 on Postcard

Combustible **Gas Analyzer**

The new Johnson-Williams Company RV-6 Combustible Gas Alarm is capable of sequentially sampling potentially explosive gases from six separate locations. In operation the unit samples continuously all locations and analyzes them point by point. Detection is accomplished by a platinum filament Wheatstone Bridge circuit. A panel mounted indicator shows the presence of combustible gases while a series of pilot lights indicates the location currently being analyzed. The instrument is equipped with alarm circuits which go into action should the gas in any of the locations



DREW SLUDGE CONDITIONERS SOLVE COSTLY BOILER PROBLEMS

Drew Boiler Water Treatment includes several highly effective Sludge Conditioners such as Drew Organic AL. Each has been developed to correct specific conditions in industrial water systems.

One major southeastern manufacturer was having difficulty with sludge and scaling in 13 boilers in 5 plants. Drew recommended a treatment of alkali, phosphate and Drew Sludge Conditioner AL. The entire system was cleaned up quickly and there has been no further trouble, costly maintenance or parts replacements.

To prevent or eliminate industrial water problems in your plant, you'll get results faster and more economically with this Drew program:

1. Thorough study and analysis of the problem
2. Use of effective organic and inorganic products
3. Efficient methods of feeding products to the system
4. Control of dosages by simplified plant testing
5. Service by qualified field engineers.
6. Technical assistance by the Drew Technical Department

Write for booklet "Complete Boiler Water Conditioning" and technical bulletins.

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

SAN FRANCISCO CHICAGO PHILADELPHIA BOSTON DALLAS ASHEVILLE, N. C. AJAX, ONTARIO

Service throughout the United States, Canada and South America

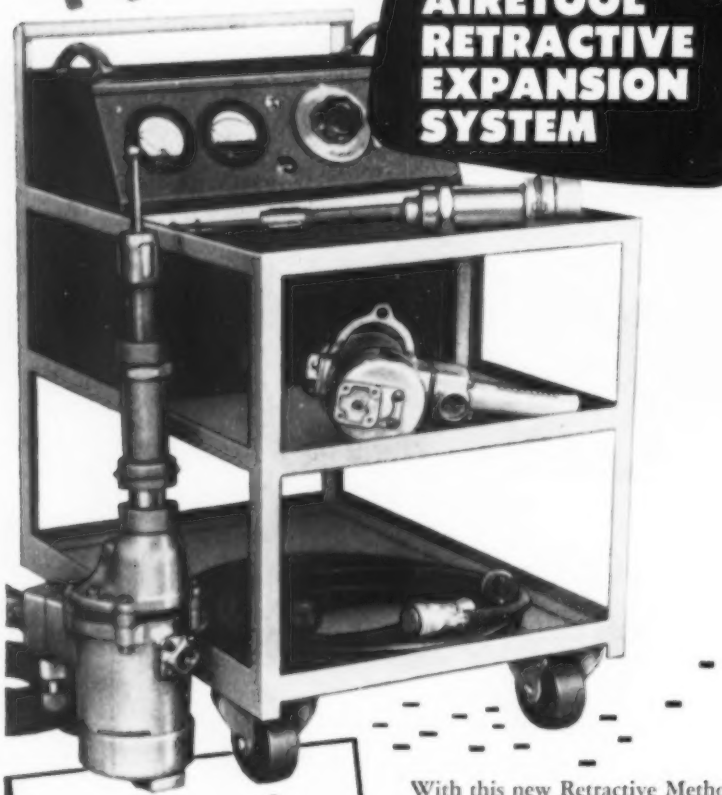
DREW PRODUCTS

NOW

Roll tubes into thick tube sheets automatically! . . . from the inside out! with the

NEW

AIRETOOL RETRACTIVE EXPANSION SYSTEM



With this new Retractive Method of Tube Expansion, the expander is fully inserted and rolls a short section of the tube. When full expansion is reached, it then automatically starts to retract. Keeps rolling as it retracts, gives full expansion to the tube the entire thickness of the sheet.

Advantages?

just check them!

- √ Draws tube metal toward mouth, eliminates inward elongation.
- √ Each joint rolled automatically to predetermined tightness.
- √ Eliminates slow, costly steprolling.
- √ Continuous process rolling shortens rolling time.
- √ Tube sheets protected against distortion, enlargement of holes.

To learn more about this efficient new Retractive Method of expanding high pressure tubes—write for your copy of AIRETOOL Bulletin No. 54.

AIRETOOL

MANUFACTURING COMPANY

SPRINGFIELD, OHIO

There's an AIRETOOL Tube Cleaner and Tube Expander for Every Type of Tubular Construction.

Branch offices: New York • Chicago • Philadelphia • Tulsa • Baton Rouge • Houston • Hudson Heights (NJ)

Representatives in principal cities of U.S.A., Canada, Mexico, South America, England.

NEW Equipment . . .

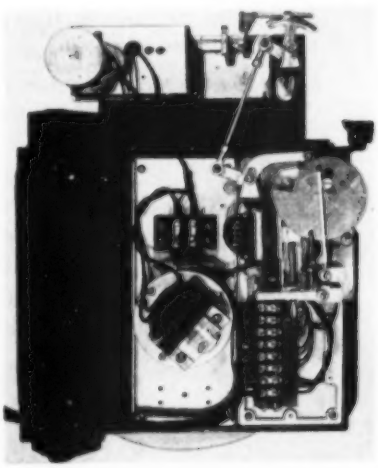
being analyzed reach a preselected level. Get the information you need for your application, simply . . .

Circle No. 18 on Postcard

Electric **Timer**

Available in two models, seconds and tenths, minutes and hundredths, the new electric timer developed by Lab-line, Inc., is suitable for all kinds of timing operations in which stopwatches are normally used. Its counter has quadruple bearings for longer life, its motor has double the usual starting torque to give instant pick-up accuracy, and its built-in brake gives instant stop. The start and stop switch of the timer is rated at 10 amperes. Assembled in an aluminum case, it is reset by a convenient thumb wheel.

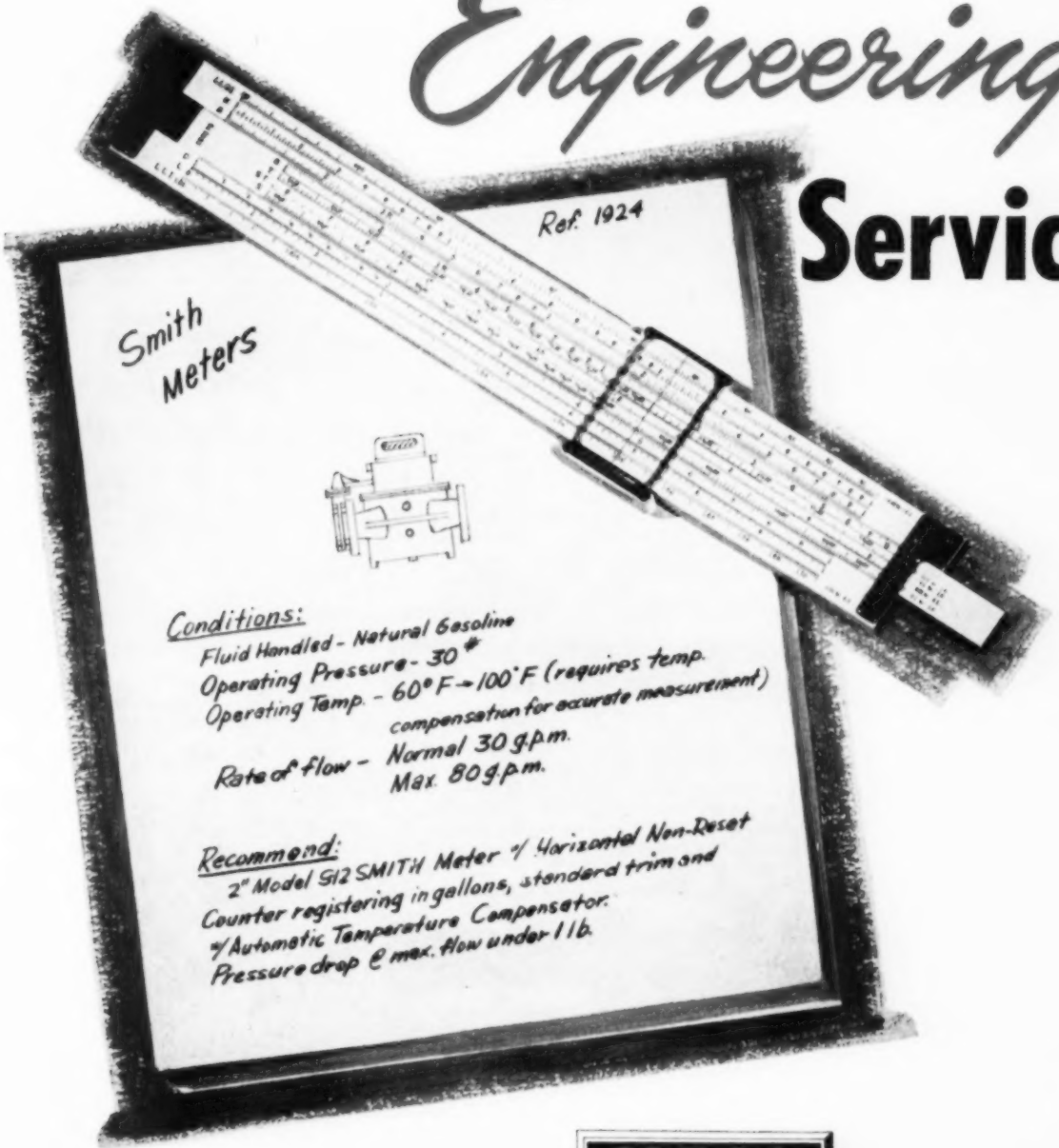
Circle No. 19 on Postcard



Electronic **Flow Meter**

A new flow meter of the electronic type which makes use of mercuryless bellows type transmitters has been announced by The Hays Corporation. This meter is available in several different

Equipment with *Engineering* Service


Ref. 1924
Smith
Meters
Conditions:
Fluid Handled - Natural Gasoline
Operating Pressure - 30 #
Operating Temp. - 60° F → 100° F (requires temp. compensation for accurate measurement)
Rate of flow - Normal 30 g.p.m.
Max. 80 g.p.m.
Recommend:
2" Model 512 SMITH Meter w/ Horizontal Non-Reset Counter registering in gallons, standard trim and w/ Automatic Temperature Compensator.
Pressure drop @ max. flow under 1 lb.

MECO

MAINTENANCE *Engineering* **CORPORATION**

P. O. BOX 2637

3711 CLINTON DRIVE
HOUSTON, TEXAS

We have the answer to your Oil Heating Problems

SUCTION TYPE TANK HEATERS

Installed at the base of bulk storage tanks, these heaters bring oil to the proper temperature for easy pumping. They heat the oil only as it is withdrawn, thus reducing radiation losses to a minimum. U-bend heating element and sheath are designed for easy installation into the storage tank by welding, riveting or bolting. Heavy gauge tubes welded to tube sheet assure long equipment life.

TYPE V-1 STANDARD OIL HEATERS

These heaters, built in four standard sizes, are maintained in stock at all times for prompt delivery. Heater incorporates straight tube bundle with tube sheet welded to shell, minimizing the number of joints. Type V-1 is designed for economy, simplicity, and ease of cleaning. No line connections need be broken to enter the tube circuit.

TYPE W OIL HEATERS

Special Whitlock expansion member compensates for differential expansion or contraction between shell and tubes. Standard sizes are designed for working pressures of 250 psi. on both shell and tube side, but can be supplied for higher oil or steam pressures when required. Straight tubes facilitate cleaning.

WHITLOCK

Find out about these and other Whitlock Oil Heaters. Write for Bulletin 35, or send specifications on your particular requirements. The Whitlock Manufacturing Company, 75 South Street, Hartford 10, Conn. In Canada: Darling Bros., Ltd., Montreal.

* * *

Whitlock Designs and Builds: bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

NEW Equipment . . .

models for indicating, recording and, with a continuous type mechanical integrator or combinations thereof, for measurement of the flow of fluids such as steam, water and gases. Records of air flow for boiler operation and pressures and temperatures can be combined into the same meter.

The meter is also available for the measurement of liquid level in an enclosed vessel such as a boiler drum. The transmitter for this application differs from the others in that it is of the buoyant float operated type with torque tube assembly.

Other features of the meter pointed out by the manufacturer include: unaffected by normal voltage, frequency, temperature variations or reasonable length of transmission lines; 3 to 1 range calibration at recorder; high accuracy; 12-inch, uniformly graduated charts; no integrator creep at zero; easy micrometer zero adjustment; indicator can be calibrated for direct reading.

Circle No. 20 on Postcard

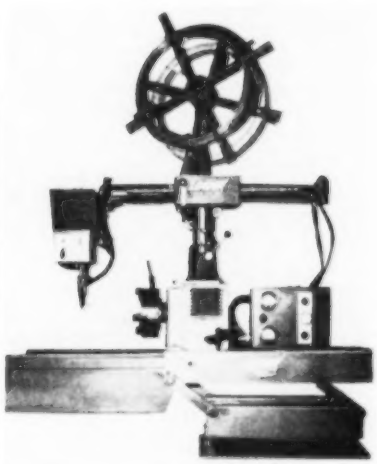
Teflon-Asbestos **Packing**

Industrial rod packings of braided asbestos, using an impregnation of 35 percent Teflon, are now being offered by United States Rubber Company.

The new type of packing is expected to provide longer service than previously available rod packings because of its higher resistance to acids, alkalies, and virtually all petroleum and coal tar solvents. Satisfactory performance can be expected at all temperatures from —90 F. to 500 F.

This item supplements United States Rubber Company data on pages 989-1004D of The Refinery Catalog, 20th Edition.

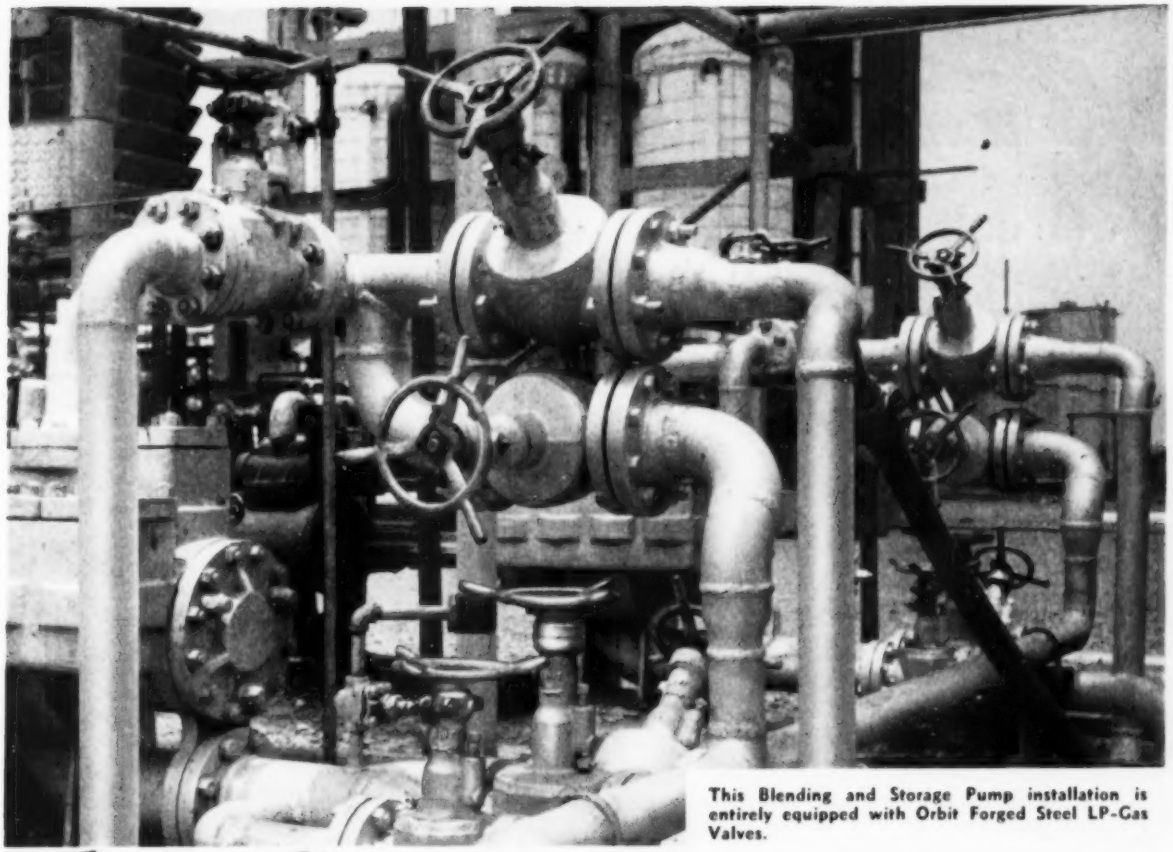
Circle No. 21 on Postcard



Portable **Welding Unit**

Leader Welding and Manufacturing Company's model 450 Tool Joint Unit is a complete, portable, automatic welder built specifically for tool joint rebuilding in the field.

It has a gasoline-driven, 400-amphere d.c. arc welder; a 35-volt control generator; a 110-volt auxiliary power supply; push-button, battery-powered



This Blending and Storage Pump installation is entirely equipped with Orbit Forged Steel LP-Gas Valves.

First Choice for Handling Light Ends

Orbit Forged Steel LP-Gas Valves insure a vapor tight shut-off, eliminating contamination. Reruns are eliminated and product quality is maintained. Besides there are no voids in the body of an Orbit LP-Gas Valve to trap fluids that could become dangerous in case of fire. When the valve is closed it drains clean to either side of the line — in case of reversed pressures it still holds vapor tight.

Adjustable plastic stem packing is utilized that can be added to, if necessary, while the valve is in service and under pressure.

Orbit LP-Gas Valves are competitively priced. They soon pay for themselves through high type performance and low-cost maintenance. Orbit's Friction Free Seating Principle account for these advantages.

Include Orbit LP-Gas Valves on your next blue prints for a new Hydrocarbon Plant or expansion program. Install them when making replacements within your plant. Many other uses include underground and surface storage installations, tank car and truck loading racks. Orbit LP-Gas Valves carry Underwriter's Laboratory approval which you will find clearly stenciled on the body of each valve.

These valves are available in both Full Round Opening Type and Venturi Type, ASA Class. Maximum rated working temperature 250 Degrees Fahrenheit. They are all forged steel — welded bonnet construction.

Sold through Oil Field and Refinery Supply Stores throughout the country.

DISTRICT OFFICES

HOUSTON, TEXAS
407 Velasco
(Serving the Gulf Coast)

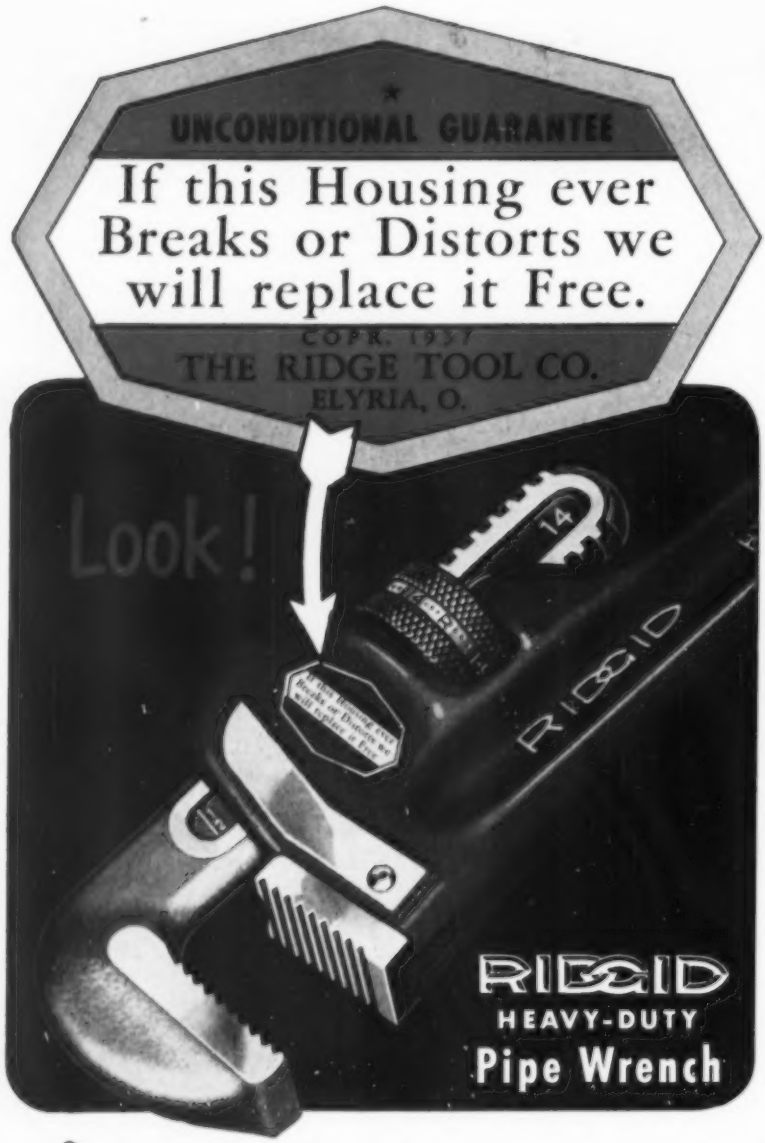
ODESSA, TEXAS
402 West County Road
(Serving West Texas)

CASPER, WYOMING
1740 E. Yellowstone
(Serving the Rocky Mountain States and Canada)

ORBIT VALVES ®

ORBIT VALVE COMPANY

P. O. BOX 699 **TULSA, OKLAHOMA**



Guarantee that has saved money for millions of users for 30 years

- ★ Housing Guarantee is specific, instant make-good, no argument.
- ★ No-slip no-lock replaceable jaws, handy pipe scale on hookjaw.
- ★ Adjusting nut that spins easily to size, 6" to 60".
- ★ Comfort-grip I-beam handle.
- ★ 100% factory pipe testing of every wrench!
- ★ Always the most for your money! Buy RIGID's at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

RIGID
Work-Saver Pipe Tools

NEW Equipment . . .

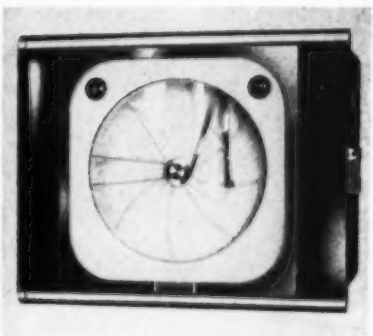
starter, and a heavy-duty, automatic welding head.

A d.c. variable-speed motor transmits power through a gear train to the main face plant, which is tapped and equipped with a heavy-duty ten-inch, three-jaw chuck with a current collector-ring to ground. A roller-mounted flux bin, fitted with screen and lock-in pin, slides in and out for use when welding or traveling.

The rebuilding material is held in dual 150#-capacity, spring-braked, adjustable reel holders. Tool joints to be rebuilt are quickly positioned on dual ball-type pipe racks which are also adjustable.

The entire unit is ruggedly-built of heavy, channel-iron to withstand years of rough use. It can be mounted on skids, truck or trailer, and is wired to permit immediate production welding in the field.

Circle No. 22 on Postcard



Program Controllers

The Bristol Company electronic dynamaster recording potentiometers are now available in the form of time-temperature program controllers. These new units regulate temperature according to a predetermined schedule of changing values. Any desired program, such as heating, soaking and cooling cycle, can be accurately maintained. The same controller can be used to maintain any number of different temperature programs, since cams of different contour are easily cut and interchanged. The instruments employ an electronic control system with proportional input action optionally available.

Circle No. 23 on Postcard

Furnaces

Petro-Chem Development Company has made available a new bulletin describing isoflow radiant convection furnaces. The isoflow design consists of an upright cylindrical steel structure with an integral self-supporting stack. Bulletin 53-1 describes construction and explains operation of the units.

Circle No. 24 on Postcard

Unique Gasket Material

The Connecticut Hard Rubber Company has announced a new and unique type of gasketing material. Combining

ATLAS PROCESSING COMPANY at Shreveport, Louisiana, has recently placed in operation this Hudson-Built benzene recovery plant, the first to recover substantial quantities of natural benzene from liquid hydrocarbons extracted from natural gas. Over 98% of the benzene present in motor fuel base stocks produced in gas processing plants in the Carthage gas distillate field of East Texas is extracted in this unit. The benzene is nitration grade, having a purity of over 99.6%. Hudson is proud of its part in implementing the concept of the Atlas management in this pioneering operation.

HUDSON
ENGINEERING CORPORATION
FAIRVIEW STATION • HOUSTON, TEXAS

Okadee

"THE PERFECT SEAL"

WRING FIT

No magic . . . No magnetism . . . lapped wring fit of every Okadee Valve disc and seat must pass this test of a perfect sealing surface. (unretouched photo)

. . . Here's What it Means to You in Terms of Valve Service

Flat mating surfaces within .000005", or less, of every set of Okadee valve discs and seats mean absolute shut-off of any material from ammonia gas to asphalt.

How long does this seal last in service? We honestly don't know. Tests under working conditions with propane were stopped after 269,000 operating cycles when no wear or seal failure could be detected. And Okadee valves do not have to be babied in service on corrosive or abrasive materials . . . Thousands of boilers have had Okadee blow-down valves in continuous, trouble-free service for fifteen years or more. If Okadee size-pressure-temperature ranges include your valve applications, Okadee installation will end your problems of valve performance once and for all.

Okadee valves are available in single-disc (one direction) and double-disc (two directions) types; screwed or flanged; ½" to 6" in standard A.S.A. dimensions; steel or semi-steel bodies (other materials to order); stainless steel or stellite seat facings; levers, rack-and-lever, worm-gear, hydraulic, pneumatic, automatic on-off control.

Write for Bulletin 332-G today!

OKd. Okadee COMPANY

332 South Michigan Avenue • Chicago 4, Illinois

NEW Equipment . . .

the chemical resistance of the fluorocarbons with the resilience of the silicon rubbers, these gaskets should be of great use in the petrochemical industry. The silicone rubber center, which is completely enclosed by a fluorocarbon jacket, may be sponge or solid and of various degrees of softness. For more information on this new development . . .

Circle No. 25 on Postcard

Recording Equipment

A new Leeds & Northrup Company apparatus reportedly solves problems in combustion, process, product and safety control by employing oxygen as the direct source of measurement. By providing a complete and concise oxygen record at all times, L&N oxygen recording equipment is said to help maintain correct O_2 for combustion and in various plant or process operations.

The equipment provides a high speed of response: initial, 8 to 12 seconds; 90 percent of final reading, 35 seconds. L&N calibrated accuracy of plus or minus 0.15 percent oxygen against standard gas mixtures can be adjusted by means of recorder-dial rheostats to any plant standard. This accuracy, coupled with the sensitivity of better than plus or minus 0.05 percent oxygen, provides the users, says the manufacturer, with reliable and responsive data for precise analysis of plant or process operation.

Circle No. 26 on Postcard

Vacuum Tank Cleaning

A new and unique application for a rotary pump has been reported by Visa-Clean Corporation. The application utilizes a Worthington Corporation 2GA rotary pump as the heart of the new "Visa-Clean" machine, designed for vacuumatic liquid-storage tank cleaning.

The apparatus will remove sludge, dirt, water and other impurities from liquid storage tanks, Visa-Clean reported. It can be applied to almost any type tank and almost all liquids. It has been field tested for four years on over

BLAW-KNOX *Automatic* FOG SYSTEMS

Deluge Systems, wet Pipe Systems, Dry Pipe Systems, Water Spray and Fog Systems, Rate-of-Rise Sprinkler Systems with new improved Spray Heads, Foam and Carbon Dioxide Extinguisher Systems . . . listed by Underwriters Laboratories, Inc. and approved by Factory Mutual Laboratories.

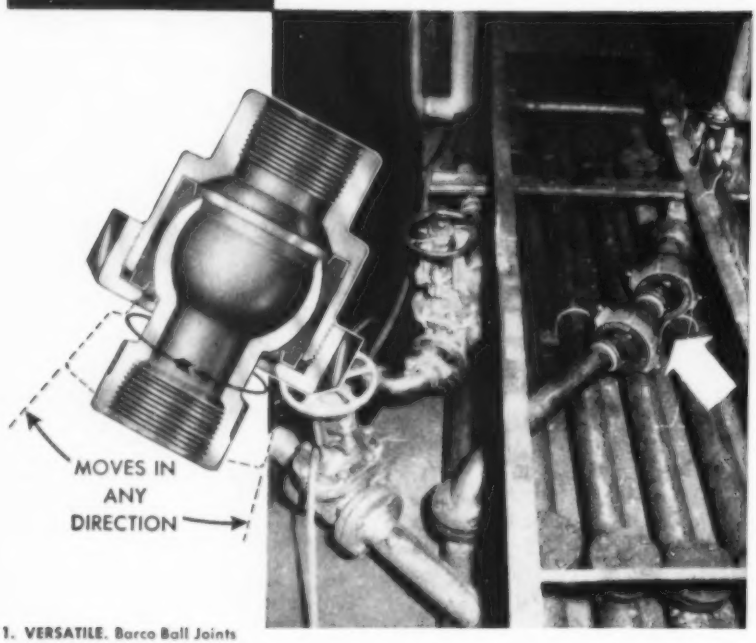
"LITTLE JOEY SPRINKLER"
Always on the Job

Here is a real fire killer . . . engineered for the hazards of this butadiene tank farm, and operating on plant water pressure. In the event of a critical temperature rise anywhere within the protected area, not a second is lost. A quenching deluge of water-fog smothers the hot spot at once. Other nozzles go into action to cool off adjacent tanks, and alarms are sounded instantaneously. To get the most effective fire protection ask for a Blaw-Knox engineer to make a survey of your property and submit an estimate . . . There is no obligation.

BLAW-KNOX COMPANY
BLAW-KNOX SPRINKLER DIVISION
PITTSBURGH 33, PA.
CEdar 1-0700

BLAW-KNOX

BARCO *Flexible* BALL JOINTS



1. **VERSATILE.** Barco Ball Joints solve many piping problems where flexible connections are needed to allow for movement, overcome misalignment, and guard piping against vibration, strain or shock.
2. **MAXIMUM FLEXIBILITY.** Up to 40° side flexibility with 360° rotating movement.
3. **MANY STYLES AVAILABLE.** Angle or straight; threaded or flanged connections. For pressures to 7,500 psi; temperatures to 1000° F. 15 different sizes, ¼" to 12".
4. **CHOICE OF MATERIALS.** Built to meet service requirements for steam, oil, gasoline, water, chemicals, and other fluids.
5. **ENGINEERING RECOMMENDATIONS.** Barco will be glad to send you complete information—ASK FOR BULLETIN No. 215.

For LUBE OIL TRANSFER LINES

■ The above photograph shows a series of manifolds which carry various types of lube oil. Note the diagonal line (arrow) fitted with two BARCO BALL JOINTS. The diagonal line is connected to a storage tank, and the blank flange on each manifold is so positioned that the line with the joints from the storage tank can be connected to any of the manifolds. This type of hook-up is used for a number of installations. At the location pictured here, the company has about 20 storage tanks in the group. The Barco Ball Joints are 3" Standard Series, Style 7-8.

As compared with conventional fixed piping, this type of hook-up eliminates a considerable number of valves, fittings, and pipe, and requires little space. Also, it is practically foolproof by giving visual indication of the manifold being used.

For complete information about Barco Ball Joints and how to use them, write to BARCO MFG. CO., 542 M Hough St., Barrington, Illinois.

BARCO

THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING AND REVOLVING JOINTS

NEW Equipment . . .

9000 jobs, with application possibilities in many industries still being explored.

Circle No. 27 on Postcard

Line Blind Valve

A new 5-bolt, 18-inch line blind valve developed by Hamer Oil Tool Company is specifically designed to fulfill growing demands by industry for a line blind valve that will accommodate large pipe lines. The new blind has an ASA rating of 150 pounds for working pressures up to 230 pounds. It provides either a full-diameter, smooth, round opening, or a permanent, leakproof shut-off. The company claims that service life is practically unlimited and maintenance is negligible.

The neck of the spectacle plate on the valve is suspended on the top bolt so that it can be revolved in either direction when opening or blinding the line. The two side bolts on the valve swing out, making unnecessary the removal of any bolts during reversal of the spectacle plate.

Regularly constructed of carbon steel, the Hamer 5-bolt, 18-inch line blind valve can be made of other materials for special requirements.

This item supplements Hamer Oil Tool Company data on page 513-564 of The Refinery Catalog, 20th Edition.

Circle No. 28 on Postcard

Controlled Volume Pumps

Milton Roy Company has announced a new pump for submerged operation. Especially designed for handling hazardous liquids, the entire fluid end assembly is submerged with only the discharge piping and driver exposed. This feature eliminates stuffing box leakage problems. The pump, a variation of the Milton Roy Minipump, will handle capacities up to 3200 ml/hr. Complete details and specifications on this new product are available now. Simply . . .

Circle No. 29 on Postcard

Infrared Gas Analyzer

The Liston-Becker Instrument Company announces a modification of its standard Model 21 infrared gas analyzer which greatly increases the sensitivity. This modified Model 21, which can detect changes as low as ⅓ ppm, is now being successfully employed in several

FROM THE HORN OF PLENTY AT BONNEY FORGE

WELDOLETS
and
THREDOLETS
for Stainless
and
Alloy Piping

STAINLESS
F 304 304 ELC F 316 F 347

CHROME MOLY
A 182 F 12 F 11 F 22 F 5

MONEL

WROUGHT IRON

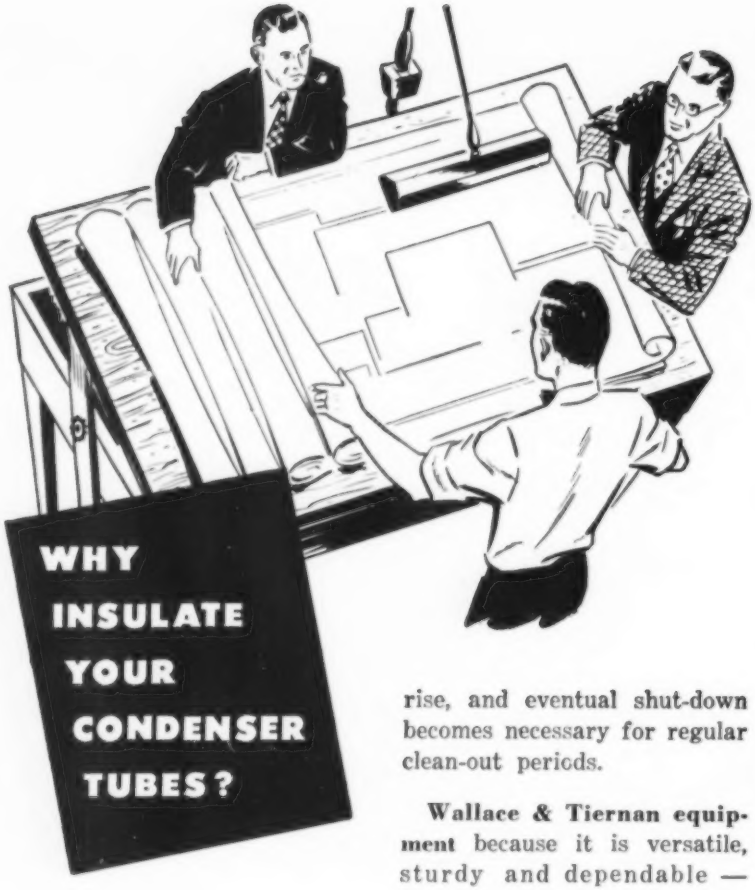
ALUMINUM

AND OTHER ALLOYS

When constructing with alloy, you're investing *real money*. Assure performance-proved fittings and save dollars by specifying and using Weldolets and Thredolets for 90° branch joints—large and small, full size and reducing.

Distributors in Principal Cities

WELDING FITTINGS DIVISION
BONNEY FORGE & TOOL WORKS
ENG. DEPT., 721 MEADOW STREET
ALLENTOWN, PENNSYLVANIA



WHY INSULATE YOUR CONDENSER TUBES?

You may be doing just that if your plans don't include CHLORINATION EQUIPMENT for slime control by WALLACE & TIERNAN.

Chlorination equipment because it controls slime that *grows* on the walls of condenser tubes not protected against it. Enough of the growth eventually seriously reduces heat transfer efficiency — actually *insulates* your steam from the cooling water. Back pressures go up, production drops, operating and maintenance costs rise, and eventual shut-down becomes necessary for regular clean-out periods.

Wallace & Tiernan equipment because it is versatile, sturdy and dependable — proven by thousands of successful installations, vouched for by satisfied users everywhere-and because there's a Wallace & Tiernan chlorinator for every job. Write today for information on how Wallace & Tiernan chlorination may help you solve *your* slime problem.

NO WATER IS SLIME-FREE

regardless of the source. Chlorination helps reduce slime in process or cooling water.

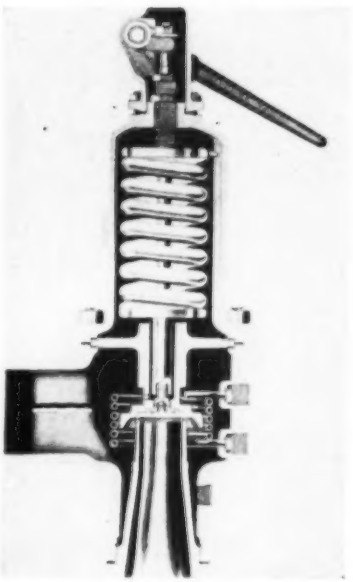
CD-37

WALLACE & TIERNAN
COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

NEW Equipment . . .

plants for measuring CO and CO_2 in the range of 0-50 ppm in ammonia synthesis gas. The basis of this new modification is this: since the IR gas analyzer is sensitive to the number of molecules in the optical path, by designing the sample cells to employ high pressures the sensitivity can be increased proportionately. In the CO and CO_2 instrument, 500 psi is used. Sapphire windows which can withstand much more than this pressure are employed in the modified instrument. For the information you need, just . . .

Circle No. 30 on Postcard



Internal **Heat Exchanger**

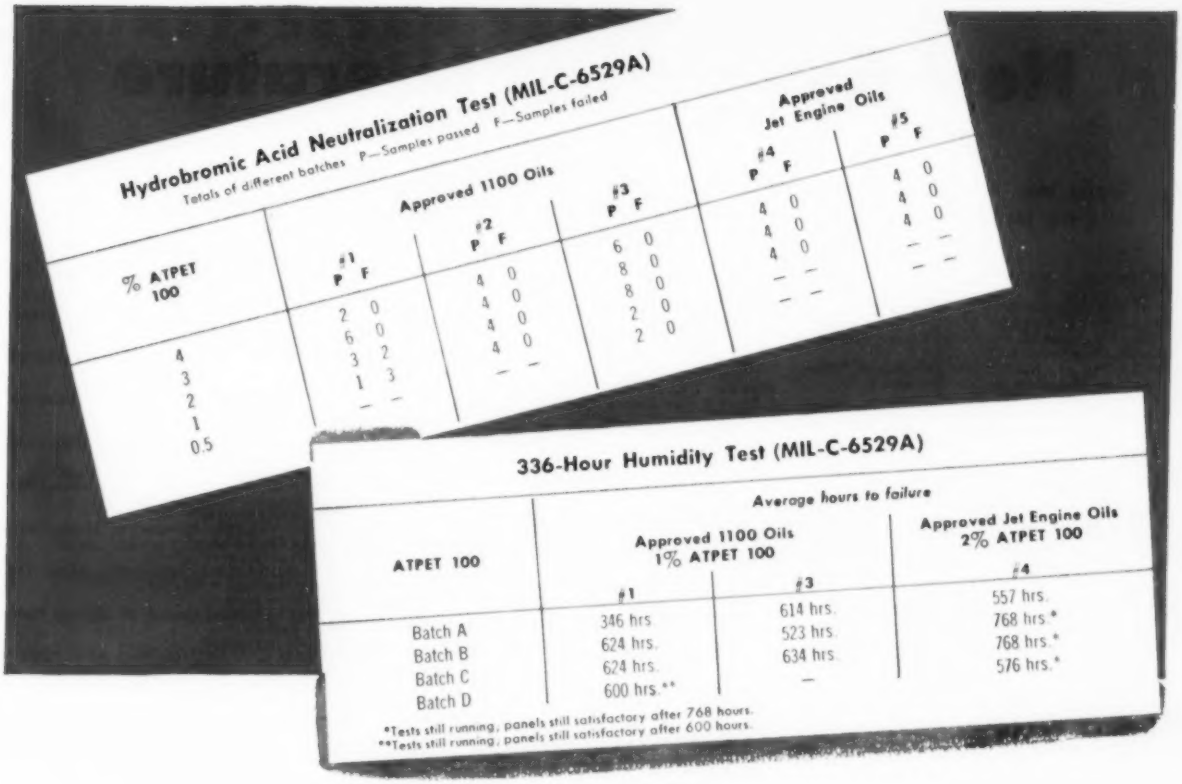
A new feature made available in all Farris Engineering Corporation nozzle and semi-nozzle safety-relief valves is an internal heat exchanger which can be incorporated into the valve body without creating interference with the rest of the valve mechanism.

The internal heat exchanger is said to eliminate the necessity of steam tracing or steam jacketing a valve when highly viscous lading is encountered. While external steam tracing or jacketing is inefficient and costly, the manufacturer reports, the Farris heat exchanger keeps the lading material in a fluid state with exceptionally low steam consumption. The unit, according to the company, "provides maximum efficiency by placing the heat where it is most effective."

The heat exchanger consists of a steel coil inserted into the valve body and led out to connect with a steam line. The coil ends are accessible for return-pipe installation or one-pipe installation with a vent valve. A steam trap drains the coils, and the construction is suitable for back pressure.

This item supplements Farris Engineering Corporation data on page 429 of The Refinery Catalog, 20th Edition.

Circle No. 31 on Postcard



Hydrobromic Acid Neutralization Test (MIL-C-6529A)

Totals of different batches P—Samples passed F—Samples failed

% ATPET 100	Approved 1100 Oils #1 P	#1 F	#2 P	#2 F	#3 P	#3 F	Approved Jet Engine Oils #4 P	#4 F	#5 P	#5 F
4	2	0	4	0	6	0	4	0	4	0
3	6	0	4	0	8	0	4	0	4	0
2	3	2	4	0	8	0	4	0	4	0
1	1	3	4	0	2	0	—	—	—	—
0.5	—	—	—	—	2	0	—	—	—	—

336-Hour Humidity Test (MIL-C-6529A)

ATPET 100	Average hours to failure: Approved 1100 Oils 1% ATPET 100 #1	#3	Approved Jet Engine Oils 2% ATPET 100 #4
Batch A	346 hrs.	614 hrs.	557 hrs.
Batch B	624 hrs.	523 hrs.	768 hrs.*
Batch C	624 hrs.	634 hrs.	768 hrs.*
Batch D	600 hrs.**	—	576 hrs.*

*Tests still running, panels still satisfactory after 768 hours.
**Tests still running, panels still satisfactory after 600 hours.

ATPET 100

proves a superior rust inhibitor

Here's the corrosion inhibitor you've been looking for. It's ATPET 100, the new non-metallic rust preventive developed by Atlas for use in slushing oils, engine preservatives and other corrosion-preventive compounds.

Its effectiveness in protecting metal surfaces is proved by tests conducted in the Atlas laboratories, results of which are tabulated above. Compare this performance against that of any other inhibitor—and you'll see that ATPET 100 gives better protection even when used in small concentrations.

What's more, the quality of ATPET 100 stays completely uniform from shipment to shipment. And its price compares with metallics. Write today for test samples—and for full information on this economical, highly efficient oil additive.

INDUSTRIAL CHEMICALS DEPARTMENT

ATLAS POWDER COMPANY

WILMINGTON 99, DELAWARE

offices in principal cities

ATLAS POWDER COMPANY, CANADA, LTD.
BRANTFORD, CANADA

New Equipment Literature

Copies may be obtained easily and without cost by using Reader Service Postcard. Just circle on the card the identifying key number of each item in which you are interested. Postcard opposite page 216.

AIR PREHEATERS—Details. The Air Preheater Corp. See page 58.
Circle A2 on postcard.

RETRACTIVE EXPANSION SYSTEM—Bulletin No. 54. Acetool Manufacturing Co. See page 248.
Circle A3 on postcard.

CENTRIFUGAL BLOWERS—Information. Allis-Chalmers Manufacturing Co. See page 9.
Circle A5 on postcard.

TUBES AND PLATES FOR CONDENSERS AND HEAT EXCHANGERS—Publication B-2. The American Brass Co. See page 81.
Circle A7 on postcard.

COLLOIDAL CONCENTRATE—Literature. American Sand-Banum Co. See page 310.
Circle B1 on postcard.

CONTROL VALVES—Bulletin. The Annin Co. See page 34.
Circle B2 on postcard.

MAGNETIC MOTOR STARTERS—Bulletin. The Arrow-Hart & Hegeman Electric Co. See page 327.
Circle B3 on postcard.

CORROSION INHIBITOR—Information. Atlas Powder Co. See page 2-9.
Circle B4 on postcard.

ADSORBENTS, CATALYSTS, CATALYST CARRIERS AND DESICCANTS—Information. Attapulgus Minerals & Chemicals Corp. See page 70.
Circle B5 on postcard.

PUMPS—Bulletin 105-M. Aurora Pump Co. See page 238.
Circle B6 on postcard.

BALL JOINTS—Bulletin 215. Barco Manufacturing Co. See page 2-b.
Circle B10 on postcard.

PIPE THREADING AND CUTTING EQUIPMENT—Catalog. Beaver Pipe Tools, Inc. See page 305.
Circle C1 on postcard.

COOLING WATER TREATMENT—Technical Paper No. 123. W. H. & L. D. Betz. See page 289.
Circle C3 on postcard.

UNIT-SUSPENDED WALLS AND ARCHES—Information. Bigelow-Liptak Corp. See page 14.
Circle C4 on postcard.

SAFETY HEADS—Catalog. Black, Sivalls & Bryson, Inc. See page 211.
Circle C5 on postcard.

CONDENSERS AND HEAT EXCHANGER TUBES—Manual. Bridge Brass Co. See page 229.
Circle C10 on postcard.

SECTIONAL HEAT EXCHANGERS—Bulletin No. 512. The Brown Fintube Co. See page 66.
Circle C12 on postcard.

CRANES—Literature. Bucyrus-Erie Co. See page 217.
Circle D1 on postcard.

DUST COLLECTION AND RECOVERY—Information. Buell Engineering Co. See page 232.
Circle D2 on postcard.

EXPLOSION-PROOF RADIATOR—Folder. Burnham Corp. See page 231.
Circle D3 on postcard.

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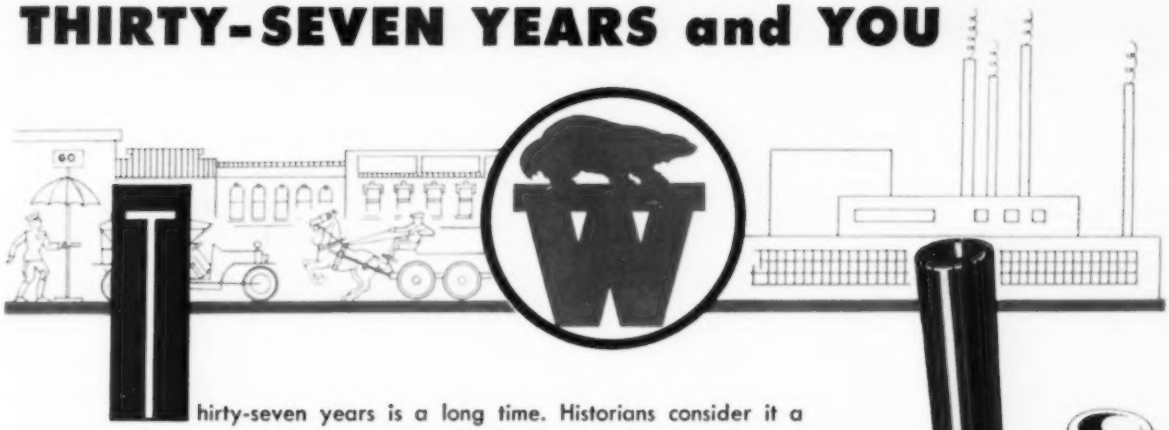

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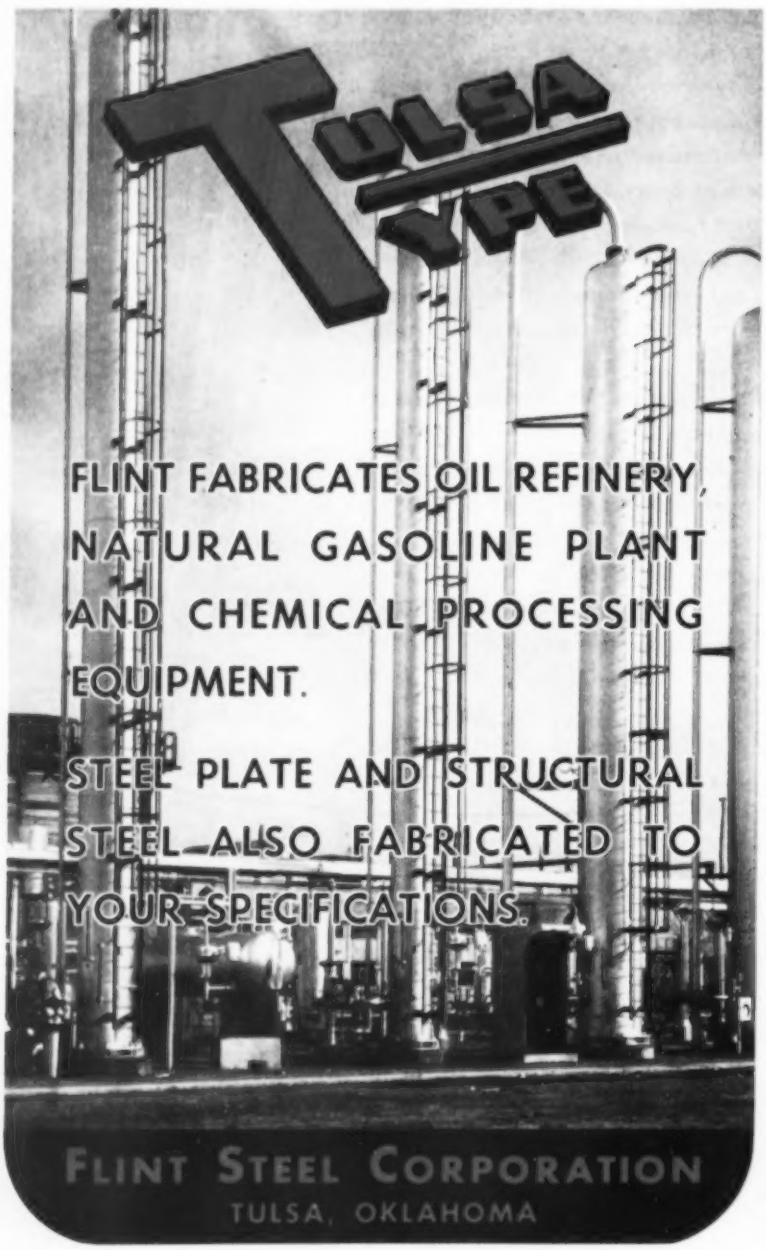
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Corrosion Control Course Set For December at Oklahoma

The College of Engineering and the Extension division of the University of Oklahoma in cooperation with the Central Oklahoma Section of the National Association of Corrosion Engineers have scheduled a corrosion control short course at Norman, Okla., December 1-4. The course, to be held at the Extension Study Center on the North Campus of the University, will consist of a four day series of technical papers and panel discussion. Everyone interested in corrosion control is eligible to attend the sessions.

Speakers and program have been selected with the object of making engineers and operating foremen better acquainted with the practical aspects of corrosion control, the school reports.

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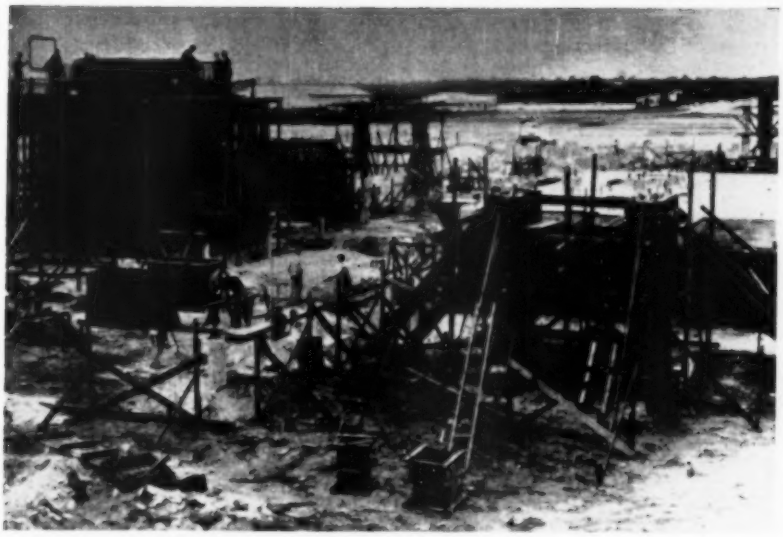


Australasian Progressing at Kwinana—

The first refining unit has been erected at the Kwinana refinery being built by Anglo-Iranian Oil Company's Australian associate, Australasian Petroleum Refinery, Ltd., near Fremantle, Western Australia. The new unit is a pressure tower through which kerosine will be passed to improve its quality.

Foundations have been laid for other refining plants, including the catalytic cracking plant (shown above) and two distillation units which will process 60,000 barrels of crude oil a day.

McNUTT Starts Operation of Platforming Unit at Brickland

A 600-barrel-a-day UOP platforming unit has been put in operation at McNutt Oil and Refining Company's Brickland, N. M., refinery. The platformer, the main unit in a modernization program which has increased the refinery's capacity, was designed, engineered and licensed by Universal Oil Products Company. Construction of the unit was handled by refinery personnel, who also revamped two existing facilities.

In other construction at the refinery, a UOP two-coil thermal cracking unit is being converted into a three-coil unit, increasing the crude capacity from 3000 to 4000 barrels a day; the capacity of the thermal cracker is being raised from 1200 to 1800 barrels a day; a new stabilization unit is being added to the thermal cracker; and the capacity of an existing UOP poly plant is scheduled to be increased by 33⅓ percent.

THIOCHEMICALS Schedules Port Arthur Plant Construction

A $500,000 plant to produce methyl mercaptan from hydrogen sulfide will be built by Thiochemicals, Inc., of Port Arthur, Texas, in that city. Cost of the plant site is $18,000. Arrangements have been made with Atlantic Refining Company to pipe waste gases from its nearby refinery to the proposed plant. Processing is due to start from pilot-plant operations early next year. Full production is expected within two years if manufacturing difficulties are eliminated.

Caltex Refinery

■ CONTINUED FROM PAGE 96

erection of a phosphoric acid catalytic polymerization unit. Design work on this polymer plant is now under way. Materials procurement and construction work will be expedited so that this plant will be completed in time for startups with the fluid catalytic cracking unit.

Contractors. The prime contractor for the project is Foster Wheeler Corporation of New York. Contracts have been let for certain aspects of the work to American Builders of Manila, and to George L. Tubb Construction Company.

NATIONAL Dedicates $50 Million Tuscola Plant

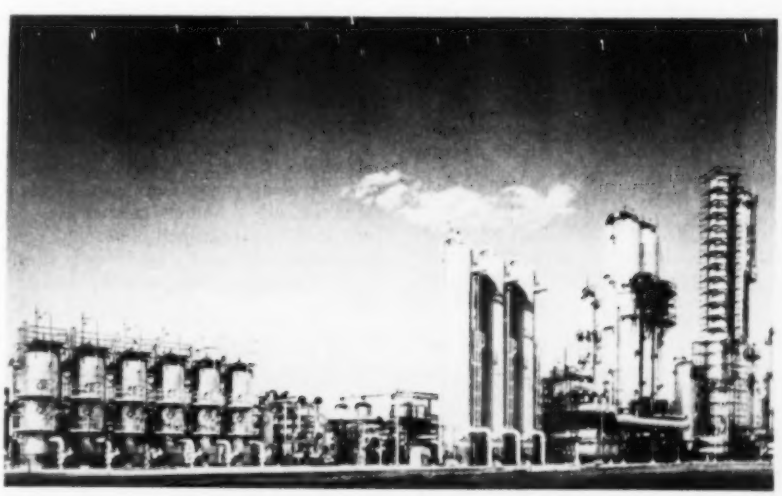
National Petro-Chemical Corporation's $50 million plant which produces hydrocarbons and industrial chemicals from natural gas was officially dedicated last month at Tuscola, Ill. The seven major units of the complex plant, (See August, 1953, PETROLEUM REFINER, p. 95) including two integrated plants of National Distillers U. S. I. Chemicals Division, were designed for the annual production of 200 million pounds of ethylene, 50 million pounds of ethyl chloride and 50,000 tons of anhydrous ammonia. The synthetic alcohol unit has a capacity of 125,000 gallons a day of 192 proof alcohol, equal to 25 percent of the nation's synthetic alcohol before this unit went on stream.

National Petro-Chemical is owned 60 percent by National Distillers Products Corporation, which manages and operates the plant, and 40 percent by Panhandle Eastern Pipe Line Company.

The new plant receives 400 Mmcf of natural gas daily from an adjacent Panhandle compressor station from which more than 700,000 gallons of mixed hydrocarbons are extracted. In the fractionation plant recovery from this extracted volume consists of 499,000 gallons of gas liquids, predominantly propane, and 10 Mmcf of ethane, the base raw material of the plant. After extraction the gas is returned to the Panhandle pipe line, and the propane, butane and natural gasoline is pumped to storage for future sale.

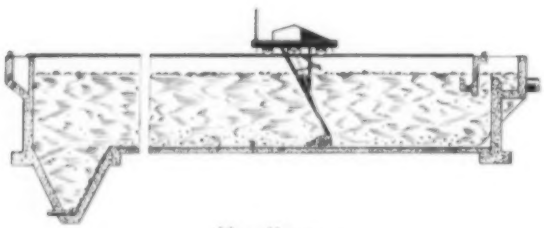
Ethane flows into the ethylene plant, the largest such unit in the country, which, after cracking, produces 600,000 pounds of ethylene daily, 8 Mmcf a day of hydrogen and minor quantities of hydrocarbons and benzene as byproducts. Small quantities of hydrogen are fed into the ethyl chloride plant, with the remainder to be used by the U.S.I. Chemicals Division synthetic ammonia plant, which is scheduled to be ready for operation by next October and will be an integrated unit of the Tuscola facilities.

Site is now being prepared at Tuscola for still another major unit. This installation will turn ethylene into polyethylene. Petro-Chemical's first polyethylene unit will be in operation by the second quarter of 1955 with initial production of 25 mil-



Dehydrators, light and heavy oil absorption towers and heavy oil stills shown above are part of National Petro-Chemical Corporation's extraction unit at its new Tuscola, Ill., plant. (See story above.)

Overall view of Hardinge Rectangular Clarifier installation at Shell Oil Company's Houston refinery. The Hardinge traveling mechanism is 41' 6" across and spans two settling sections of the 60' long oil-water separating tank.



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RECTANGULAR CLARIFIERS

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The Hardinge Rectangular Clarifier has been found to be the answer to the refinery waste water disposal problem by a number of oil refiners in different parts of the country. One or more of these units installed in the effluent waste water channel of an oil refinery will remove surface oil almost completely and most of the settleable solids or sludge, making the water sufficiently clean to permit disposal directly into nearby streams. Also, the lagoon required for the sludge is only a fraction of the size of that required for the unclarified waste water. Further, the oil skimmed from the surface can be reclaimed and sold. 30 Hardinge units are now in operation at oil refineries in this country.

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lion pounds annually. Plans have been made to double this capacity over the following two or three years.

ANGLO-IRANIAN to Build Platformers at Six Refineries

Platforming units which produce a high-grade gasoline component by a reforming process using a platinum catalyst are to be built at six refineries operated by Anglo-Iranian Oil Company and its associates.

At Llandarcy, in south Wales, the platformer will be in addition to the large current expansion program now nearing completion. At the Kent plant, south of London, the installation will form a fourth stage in the refinery's construction plan.

In addition to the United Kingdom plants, two refineries on the Continent—at Lavera, in southern France, and Hamburg, Germany—will get platformers, as will the refinery now being built at Aden, near the southern end of the Red Sea. The sixth unit will be built at the Kwinana refinery, which is under construction near Fremantle, Western Australia.

All the platformers will have a capacity of about 5000 barrels a day, except the one at Aden, which will process approximately 10,000 barrels a day.

ISRAEL Contemplating Synthetic Detergents Plant

A new plant for the manufacture of synthetic detergents may be built in Israel by Kadimah Chemical Corporation. If the proposed plant is built, a new process developed in the laboratories of Zevah Oriental Paint Company with the assistance of the Israel Mining Industry and the National Research Council of Israel will be used.

The process involves preliminary removal of aromatics from the gas oil to give as a by-product the resulting petroleum sulfonate. This is followed by a liquid phase oxidation and subsequent treatment of the oxidate to give synthetic detergents of the alkane sulfonate types as well as the fatty acids and neutral compounds usually obtained by such oxidation processes.

The plant will cost approximately $250,000, and is essentially a pilot plant. Kadimah Chemical Corporation, an American owned company, has been assigned all local and foreign patent rights. It has been manufacturing and packaging synthetic detergents in Israel since 1951.

CALTEX Ready to Start Construction of Process Units

With preliminary foundation work completion, construction of the process units at the 22,000-barrel-a-day refinery being built for the Caltex organization at Kurnell, near Sydney, Australia, will get underway this month.

One of the four refineries currently being built in Australia, the installation will be operated by the Caltex subsidiary, Australian Oil Refining, Ltd. Largest of the four is the 70,000-barrel-a-day plant which Anglo-Iranian Oil Company is building in western Australia near Fremantle.

Main units in the Caltex refinery will be a two-stage crude distillation unit, a 13,000-barrel-a-day fluid catalytic cracking unit

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BOILERS and any other special vessels requiring refractory linings.

SCHAPANSKY AND KING
CONTRACTORS
4110 DENNIS HOUSTON, TEXAS

WHO'S Building . . .

with gas recovery, a propane dewaxing unit, and a plant for finishing and blending products.

Main contract for the construction has been let to the United Kingdom company, E. B. Badger & Sons, Ltd., which is handling the job through a local subsidiary. The plant is scheduled to go on stream by mid-1955.

PAN AMERICAN Officially Starts Up Large Cat Cracker

Largest fluid catalytic cracking unit yet to be built has been officially dedicated at Pan American Refining Corporation's large Texas City, Texas, refinery.

The new unit, designed so that it has its own polymerization unit attached, will process 30,000 barrels a day of gas oil to produce over 9000 barrels of high-octane blending stock. It will be the second catalytic cracking unit at the Pan American plant.

BRAZIL COUNCIL Lets Shale Oil Plant Contract

Brazil's National Petroleum Council has signed a contract with Foster Wheeler Corporation for the planning and erection of a shale oil plant to be installed at Tremembe, in the state of Sao Paulo. Initial capacity of the plant will be 10,000 barrels a day. It will process pyro-bituminous shale existing in the Taubate/Tremembe district. Existing reserves of petroleum in the shale are estimated at 3000 million barrels.

DANAHO Starts Work on $2.5 Million Plant Expansion

A $2.5 million modernization and expansion program planned for Danaho Refining Company's Pettus, Texas, plant, will include construction of new catalytic cracking and polymerization units and revamping of existing refinery equipment. The program will increase the refinery's capacity from 4000 barrels of crude per day to about 10,000 barrels.

A contract for the engineering work has been let to Koch Engineering Company, and preliminary construction has already begun.

The present expansion program is the second for the Pettus refinery since it was purchased in 1945 by Danaho. During its first two years with the then 1500-barrel-a-day refinery, Danaho expanded the plant and replaced equipment.

INTERNATIONAL Dedicates $7 Million Wrenshall Plant

The Upper Midwest's newest refinery has been dedicated by International Refineries, Inc., at Wrenshall, Minn., just south of Duluth. The $7 million plant has a capacity of 11,500 barrels a day. Standard Oil Development Company, an affiliate of Standard Oil Company (New Jersey), licensed its refining patents to International for the installation.

Distillation, catalytic cracking and polymerization are combined into one unit at the plant. Engineers guide the operation of these three stages from a control panel and can see at a glance the temperature, pressure, and other critical conditions of each step of the vast refining process.

SINCLAIR Puts New Units In Operations at Houston Plant

A series of new refining units, constructed at a cost of $35 million, has been put into operation by Sinclair Refining Company at its Houston refinery. Included in the new facilities are a 50,000-barrel-a-day fluid catalytic cracker; a crude and vacuum still; and additional vacuum stills. A Certificate of Necessity was granted the facilities as a defense project.

The new units will enable the refinery to double its output of aviation gasoline. If necessary, approximately 5000 barrels a day can be produced.

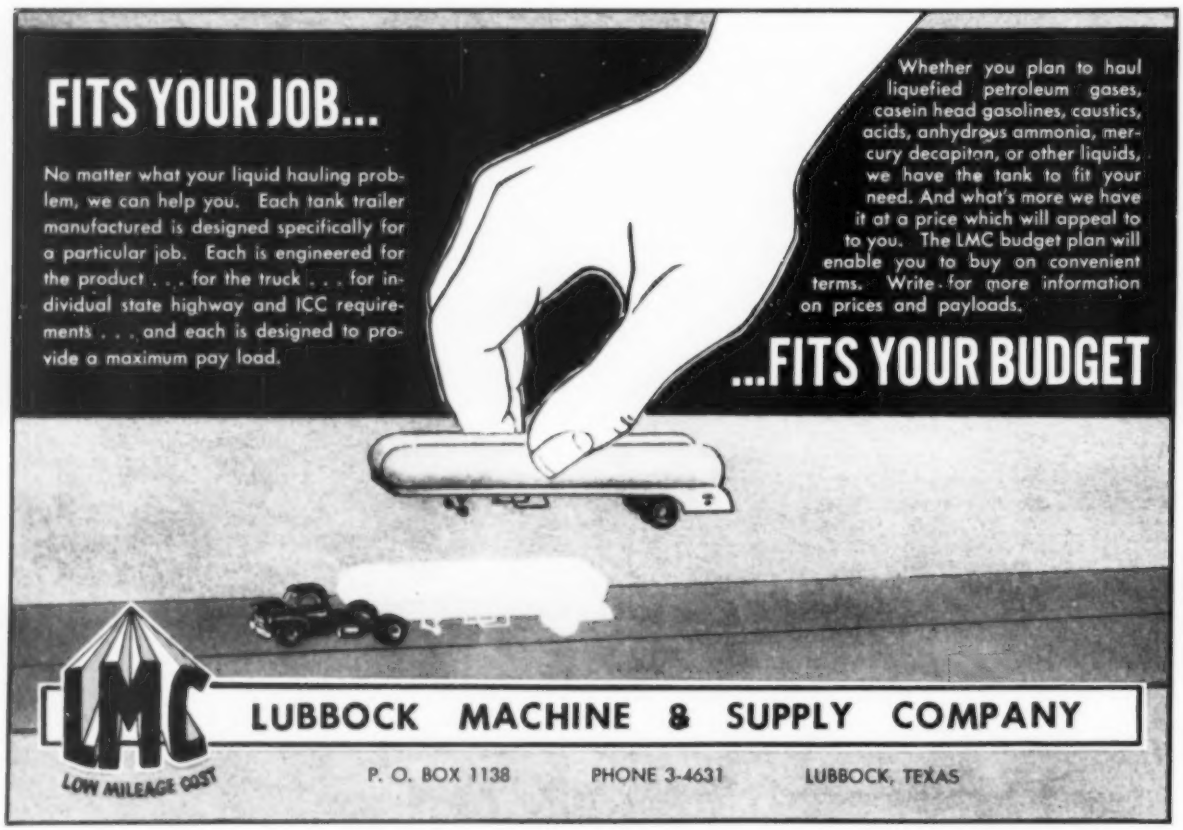
MOHAWK Announces Plans For Cat Reformer Construction

Plans for the addition of a 2400-barrel-a-day Atlantic-type catalytic reforming unit to its Bakersfield, Calif., refinery have been announced by Mohawk Petroleum Company. The construction contract for the unit, scheduled to be built early next year, has recently been awarded to Ralph M. Parsons Company. Mohawk has been licensed to operate the unit by Atlantic Refining Company.

Total cost of the project is estimated at $600,000. The unit is expected to be on stream by next April.

IRAQ Sets Aside Money for Construction of Lube Plant

The Iraqi government has allocated $9 million for construction of a refinery to produce 1000 tons of lubricating oil annually for local consumption. The government has also decided to send more Iraqi missions abroad to study oil production and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No matter what your liquid hauling problem, we can help you. Each tank trailer manufactured is designed specifically for a particular job. Each is engineered for the product . . . for the truck . . . for individual state highway and ICC requirements . . . and each is designed to provide a maximum pay load.
Whether you plan to haul liquefied petroleum gases, casein head gasolines, caustics, acids, anhydrous ammonia, mercury decapitan, or other liquids, we have the tank to fit your need. And what's more we have it at a price which will appeal to to you. The LMC budget plan will enable you to buy on convenient terms. Write for more information on prices and payloads.
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The fittings that revolutionized pipe welding . . .

In the year 1931 Taylor Forge gave industry its *first real line* of seamless, butt-welding pipe fittings. We say it was the first *real* line because it was the first to include not only long and short radius ells, but also full branch and reducing tees, concentric and eccentric reducers, stub ends, caps and welding neck flanges.

This was a fully planned development. Many years before Taylor Forge had foreseen the future of the butt-welding fitting . . . had realized that pipe welding could not go beyond its then crude stage until pipe users were given *all* the fittings necessary to make up complete piping systems.

So Taylor Forge went to work on this and after long research and development came out with the full line that became the inspiration of modern pipe welding.

Naturally the organization that started ahead has kept ahead . . . in design, in quality, in breadth of line. That is why so many men who have followed the development of the WeldELL line, refuse to consider any other kind of welding fittings.

TF

For up-to-the-minute facts, see your Taylor Forge distributor

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TAYLOR FORGE & PIPE WORKS, General Offices and Works: P.O. Box 485, Chicago 90, Ill.
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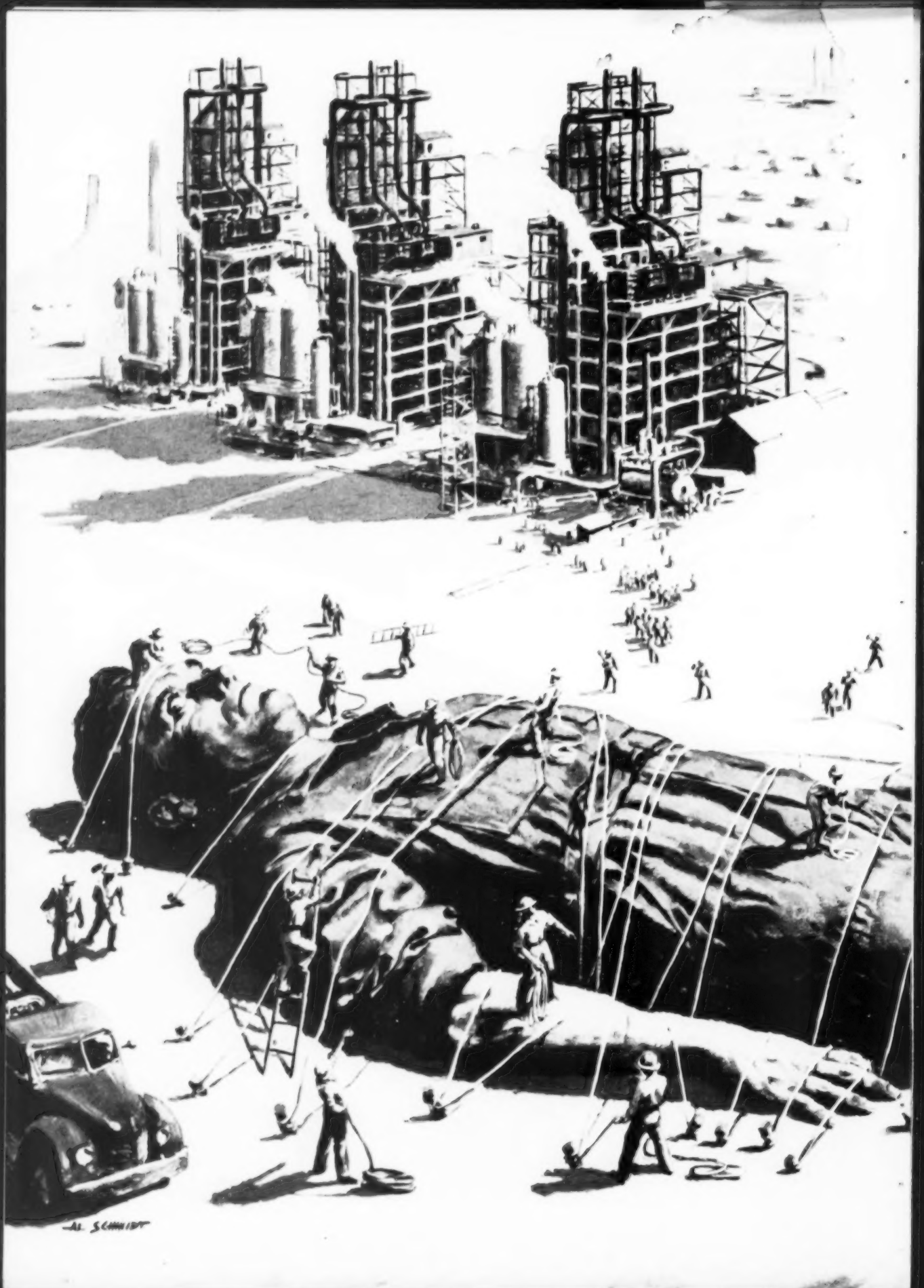
AL SCHMIDT

How Would You Go About Taming a Giant?

FOR MILLIONS OF YEARS the Giant slept.

In 1863, Man disturbed his mighty slumber, tamed him and put him to work for the good of all.

The Giant was called Petroleum.

How did enterprising men go about harnessing this stupendous new source of energy?

Here is how they did *not* go about it:

They did *not* turn the problem over to a government agency.

They did *not* say, "Whale oil is good enough. Why bother with this newfangled stuff?"

They did *not* say, "Too many problems involved. Too many risks. We might lose our shirts."

They *did* get to work and promote risk capital for drilling.

They *did* make this new source of energy available to all the people.

They *did* seek—and find—new ways to put the Giant's talents to work making hundreds of new products, creating thousands of new jobs.

Among these energetic giant-tamers were men of Cities Service. They had begun as processors of whale oil. They were quick to see the possibilities of "rock oil." They were among the first to study the sciences of combustion and petro-chemistry.

The petroleum Giant is now a docile servant of mankind. It has made our lives easier in countless ways. But Cities Service researchers say it has muscles it hasn't even used yet!

CITIES SERVICE

Quality Petroleum Products

This YORKMESH DEMISTER means Clean Separation in a Vacuum Tower
GAS OIL OUT
CRUDE IN
RESULT:
Cleaner gas oil with reduction in carbon and metals contamination which means increased yield of higher octane gasoline from your cat cracker.
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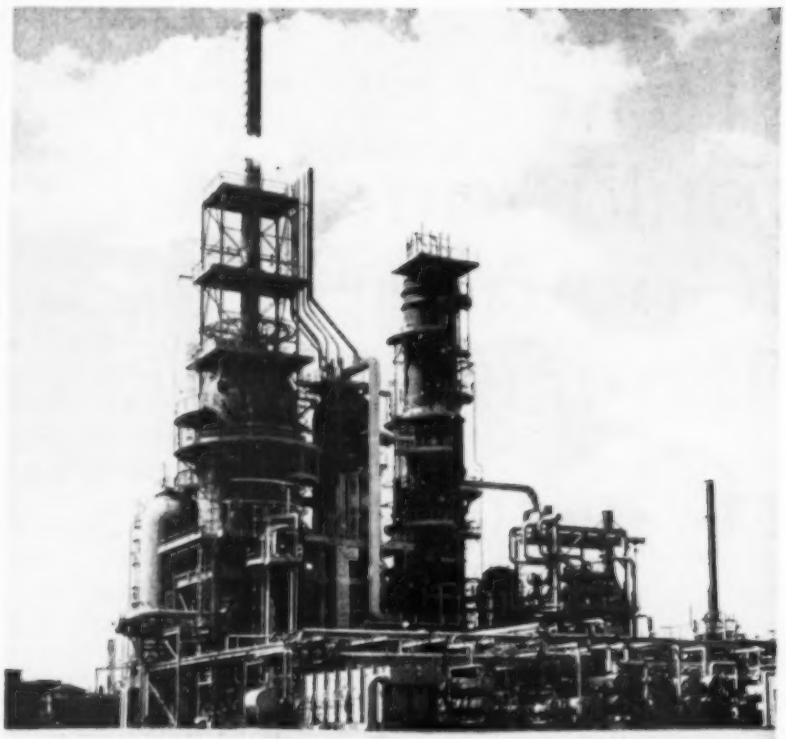
WHO'S Building . . .



The 24,000-barrel-a-day fluid catalytic cracking unit recently dedicated at the Everett refinery of Esso Standard Oil Company will boost that plant's gasoline and heating oil production to over a million gallons a day. (See story below.)

has allocated $180,000 for this purpose.

Now under construction near Baghdad is the first government owned oil refinery, with a design capacity of 24,000 barrels a day. This plant, which is expected to meet Iraq's requirements, will be ready for operation in the first half of 1955, according to best information.

ESSO STANDARD Dedicates First New England Cat Cracker

The first catalytic cracking plant in New England was dedicated last month at Esso Standard Oil Company's Everett, Mass., refinery. The 24,000-barrel-a-day Fluid unit will increase gasoline and heating oil production at the refinery to over a million gallons a day.

Dedication of the new unit climaxed a multimillion dollar modernization program that gives New England its first complete oil refinery. Total production of the plant has been raised to 2 million gallons a day.

In addition to the cracking unit, other new facilities include a 7000-barrel-a-day rerun pipestill, and new and improved light ends facilities. Crude oil thruput has been raised from 38,000 to 50,000 barrels a day, officials declared.

Process design and equipment specifications for the cracking unit and the revamping of existing units were completed by Standard Oil Development Company, central technical research organization for Standard Oil Company (New Jersey) affiliates. Process units were constructed by Foster Wheeler Corporation.

ESSO Gets Write-Off on Baton Rouge Cat Reforming Unit

Office of Defense Mobilization has granted Esso Standard Oil Company a rapid tax write-off on its 27,700-barrel-a-day catalytic reforming unit to be built at its Baton Rogue, La., refinery. In all the company received write-off grants on $17,850,600 facilities. Esso was given rapid tax write-offs of: 100 percent on $1,300,000 aromatics facilities; 65 percent on $11,690,000 basic refining; 45 percent on $4,650,000 auxiliary facilities, and 15 percent on $210,000 for buildings.

Other projects approved for fast tax write-off by ODM, with name of company, location of facilities, type of facility, total certified, and percentage certified, were:

Phillips Petroleum Company—Sweeney, Texas, 16,000-barrel-a-day catalytic reforming unit, $5,424,000; 65 percent on $4,061,200 reformer; 45 percent on $1,208,700 auxiliary, and 15 percent on $154,100 building.

The Atlantic Refining Company—Port Arthur, Texas, 8000-barrel-a-day catalytic reforming unit, $3,158,080; 65 percent on $2,587,470 refining facilities; 45 percent on $541,700 auxiliary facilities, and 15 percent on $28,910 buildings.

Pan-Am Southern Corporation—El Dorado, Ark., 7200-barrel-a-day catalytic reformer, $2,900,000; 65 percent on $2,205,000 reformer; 45 percent on $564,000 auxiliary, and 15 percent on $131,000 building.

Bay Refining Company—Bay City, Mich.,

DU PONT REG. U.S. PAT. OFF.

PETROLEUM CHEMICALS DIVISION

NEWS

DU PONT REG. U.S. PAT. OFF.

November ★ One of a Series of Interest to the Petroleum Industry ★ 1953

When the customer says

"WHY CHANGE OIL?"

This new Du Pont folder will help your dealers to have a ready answer

The need for oil change at regular intervals has been frequently attacked in the public press. As a result, many motorists resist the service station operators' efforts to protect their cars with regular oil changes.

To help your dealers cope with this situation, Du Pont has prepared a small folder on the main reasons for changing crankcase oil. The copy is short, snappy, and easy to remember. Each point is clearly illustrated by a cartoon drawing.

For sample copies and information on how to obtain the folders for your dealers, write to any Du Pont Petroleum Chemicals Division district office. The title is "When the customer says '*Why Change Oil?*' "

How much do price and credit influence gasoline buying?

Du Pont's 4th survey report on consumer gasoline buying habits indicates motorists are not as price conscious as previously believed

Do "price wars" have any justification? Are credit cards business getters? Do local charge accounts build station or dealer loyalty?

Some of your customers have told us their answers to these important questions. And what they say may have a vital bearing on your future marketing plans. To help marketers solve the riddle of the dollar sign, the Du Pont Petroleum Chemicals Division is now distributing Report No. 4 of its nationwide survey of consumer gasoline buying habits.

THE INFLUENCE OF PRICE, credit cards and charge accounts on gasoline purchasing patterns is analyzed in the 4th report in Du Pont's continuing series.

Cartoon Storyboard for Showing Survey Data at Dealer Meetings

Buying habit statistics are an important ingredient in any sound marketing program. But at a dealer meeting, plain statistics are likely to cause an epidemic of sleeping sickness.

To help you present – graphically and entertainingly – the basic marketing information in the Du Pont Buying Habit Survey, we will be glad to prepare for you a rough cartoon-style storyboard. This can be easily made into an entertaining sound slide film.

The storyboard weaves the factual survey data into a cartoon-style chain of events involving the relationship between dealer and customer. Key facts are put in terms of the dealer's own yardstick of personal experience. And the script is tailored to fit your own brand and individual marketing problems.

Several oil companies are already using sound slide films made from Du Pont-prepared storyboards. They are highly enthusiastic about the results obtained.

The average motorist, the survey found, is well informed on gasoline prices and the price difference between grades. In fact, three out of four said the price they paid for gasoline was generally the same as for competing brands. (And prices reported in the survey agreed with posted prices in the areas studied.)

"PRICE WARS"

It may surprise some marketing executives to learn that few of the motorists interviewed even recall "price wars." And still fewer switched brands or stations to take advantage of such drastically reduced prices.

And price is no deterrent in the sale

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED *Price and Credit*

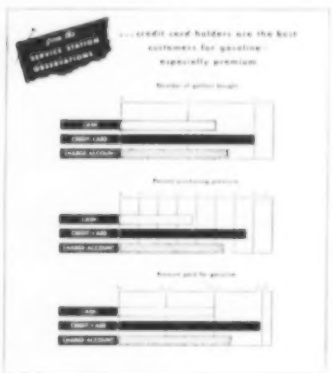
of the better grade of gasoline. Moreover, the frequency of premium purchase is greatest in areas where higher premium prices prevail.

CREDIT CARDS

The survey shows that 12% of the motorists in the U. S. hold oil company credit cards. But the percentage varies widely in different geographic areas. In the West, for example, nearly 30% hold credit cards. Service station observations show that the possession of a credit card practically assures that it will be used—and used regularly.

Good credit generally denotes a good customer. And this holds true in gasoline marketing as well as in any other business.

Credit cards are used most extensively by the upper income groups, and more than half the credit card holders say they use the card for services and products other than gasoline. Credit card holders are, therefore, in most cases, "best" customers.



THESE CHARTS from Report No. 4 of "The Service Station and the Motorist," based on actual service station observations, show that credit card holders are the "best" gasoline customers.

CHARGE ACCOUNTS

Almost 27% of the motorists interviewed said they have a charge account at a local service station. Point-of-purchase observations show that 14% of gasoline purchases are by charge account.

In contrast to credit cards, charge accounts are largely a personal arrangement between an individual dealer and his customers. And, independent of brand loyalty, a dealer's personal friendship with his customers generally determines the amount of his charge account business.

QUALITY FACTOR

Only about 10% of the total gasoline market are "price buyers." However, the number of motorists who buy premium because they associate high price with high quality is almost as great.

National in scope, the Du Pont survey is based on 3,100 household interviews and 21,000 observations at 1,193 service stations. The previous three reports covered service station selection and loyalty, brand name recognition and loyalty, and gasoline grade preferences. Future reports will deal with oil and TBA purchases and dealer services.

The information made available to the oil industry through this survey, we believe, will be extremely useful in planning merchandising and promotion programs.

Eastern District Assistant Manager

BARRY V. CORNWALL

BARRY V. CORNWALL, now assistant manager for the Eastern district, joined the Petroleum Chemicals Division in 1952 as technical assistant to the director of sales.

He has been associated with the Du Pont Company since 1929. His first assignment was as a technician in the service laboratory of the Dyestuffs Division. He later became a salesman for anti-freeze and industrial solvents in the Alcohol Division.

Prior to his transfer to the Petroleum Chemicals Division, Mr. Cornwall was assistant sales manager of the Alcohol and Camphor Section.

Born in Winnipeg, Canada, he graduated from Clemson College. During World War II, he served four years in the U. S. Army.

Storage Tests Recommended For Fuel Oil Additive No. 2

If you have been trying to determine the effectiveness of Fuel Oil Additive No. 2 in your own stocks by an accelerated method, you may have been discouraged by the results.

For a true indication of the effectiveness of Du Pont Fuel Oil Additive No. 2, you cannot depend entirely on accelerated tests. *Storage* tests at temperatures approximating field conditions should be used whenever possible.

However, if actual storage tests take too long to be practical for your purposes, storage tests at a temperature of 110° F. is a good compromise. This accelerates aging enough to give comparisons in a few weeks. But the temperature isn't high enough to invalidate test results.

Samples of Fuel Oil Additive No. 2 for testing are available from any Du Pont Petroleum Chemicals Division district office.

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A-6203

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Who's Building . . .

6000-barrel-a-day catalytic cracking unit and 300-barrel-a-day polymerization unit to process additional 4000 barrels a day of crude oil, $2,847,708; 65 percent on $2,156,595 basic refining; 40 percent on $684,713, and 15 percent on $6400 buildings.

AQUILA Plans Erection of New Thermofor Cat Cracker

A 7000-barrel-a-day Thermofor catalytic cracking unit will be erected at Aquila S.p.A. Technico-Industriale's Trieste, Italy, refinery. The unit will be similar in design to the one recently constructed at Vickers Petroleum Company's Potwin, Kan., refinery. Southwestern Engineering Company, Los Angeles, has the contract for engineering the Aquila unit. Construction will probably get under way the first half of next year.

The Aquila refinery has a capacity of about 15,000 barrels a day, with 3300 barrels a day in thermal cracking. Two years ago, a new reforming unit, lubricating oil and wax plants were installed.

AMERICAN CYANAMID Rigs Methylstyrene Pilot Plant

A new process for synthesizing a new form of methylstyrene is in the pilot-plant stage at American Cyanamid Company's research laboratories at Stamford, Conn. The raw charge is petroleum toluene and acetylene from natural gas. The reaction product is catalytically cracked to produce the methylstyrene. Methylstyrene polymers, which are thermo-plastics, find use in injection moldings, surface-coating resins, and low-pressure laminates. American Cyanamid has not revealed whether it will follow through with commercial production.

SIGNAL Awards Contract For Tioga Gasoline Plant

Brown and Root, Inc., of Houston, has been awarded the contract to install the large towers and tanks and all interconnecting piping of the natural gasoline plant being built by Signal Oil and Gas Company at Tioga, N. D. Signing of the contract would seem to indicate that the design and engineering phase of the gasoine plant project has nearly been completed and that a substantial part of the foundations has been constructed.

The building of this plant was announced last March and is being designed to process 65 Mmcf of gas per day from the Beaver Lodge and Tioga Fields for the extraction of natural gasoline, LPG and sulfur.

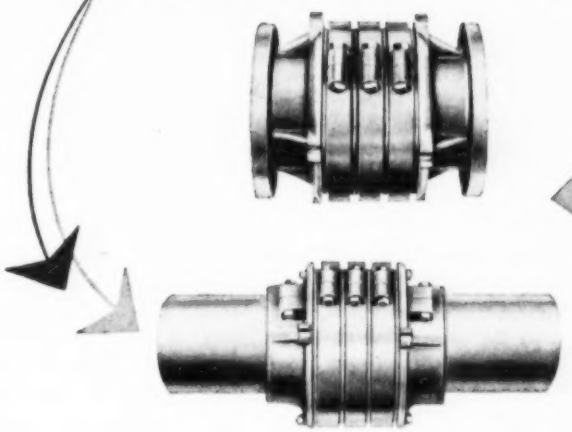
BEN FRANKLIN Starts Up Fluid Cat Cracker at Ardmore

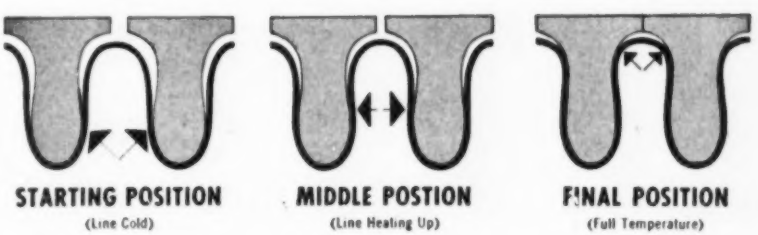
A new UOP high conversion fluid catalytic cracking unit, designed for 5000 barrels a day of fresh feed stock at 75 percent conversion, with a coke burning capacity of 7550 pounds per hour, has been put on stream at Ben Franklin Refining Company's Ardmore, Okla., refinery. At the same time, a gas concentration unit, a polymerization unit and an LPG unit also were placed in operation. Previously, a thermal cracking unit was revamped into a single-

Badger

Directed Flexing

EXPANSION JOINTS





SOME POINTS TO *Check* WHEN BUYING JOINTS

- Does the joint require packing and other maintenance?
- What's the shape of the corrugation?
- What's the shape of the equalizing rings?
- Is there any meaning to these shapes?
- What's the nature of the flexing movement?
- Is this movement well distributed?
- What's the depth of the corrugation?
- What relationship, if any, with the traverse to be absorbed?
- What kind of heat treatment was used in manufacture?

A check on these points, among others, should lead you straight to the Badger Directed-Flexing Self-Equalizing Expansion Joint You can get it in a wide range of standard diameters; in copper or stainless steel ; with flanged or welding ends; in single or double units.

BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

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IS WAX one of

. . . Compare your present moulding method with the production-proven GREER 10-pound Automatic Wax Moulding Machine and the latest development in the wax-moulding field—the new GREER ¼-pound Automatic Wax Moulding Machine.

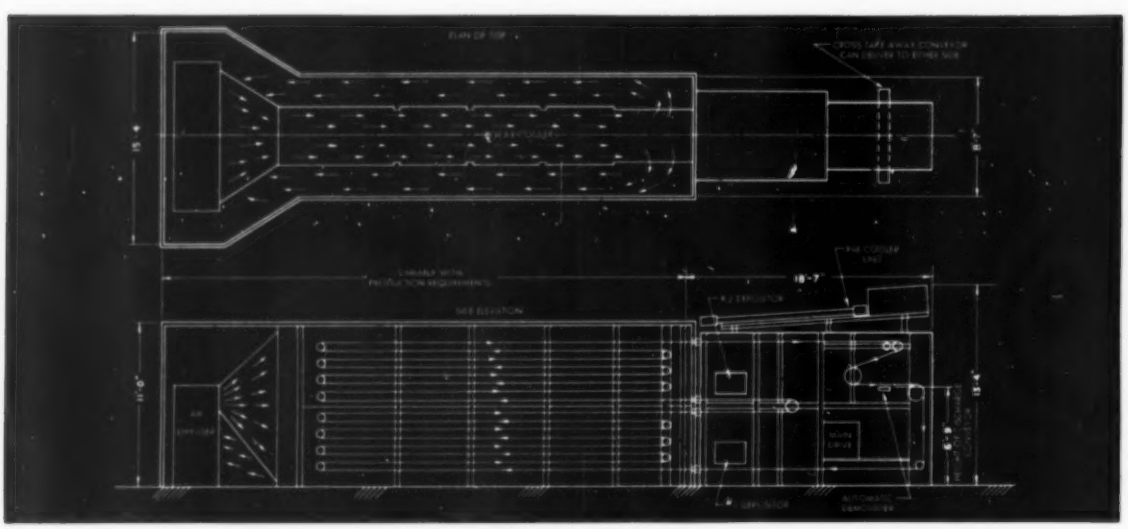
FOR EXAMPLE:

WHAT ARE YOUR WAX-SLABBING LABOR REQUIREMENTS? Either the ¼- or 10-pound GREER Wax Moulding Plants require only one man for the production of up to 15,000 pounds of wax per hour in 10-pound cakes, or up to 2,500 pounds of wax per hour in ¼-pound cakes.

OF COURSE YOU WANT HIGHEST PRODUCT QUALITY AND UNIFORMITY. Dependable control over the depositing, cooling, and demoulding operations performed by the machine assure an attractive product readily accepted by consumers. A volumetric depositor of Greer design eliminates air entrapment and holds individual cakes to within ±½ to 1% in weight for a given setting.

SANITARY OPERATION. The Greer Wax Moulder is completely automatic thereby eliminating spillage, unsightly conditions and waste.

HERE'S HOW YOU GET A BONUS IN EXTRA PLANT FLOOR SPACE. Because Greer Automatic Wax Moulding Plants require only approximately one-tenth the floor space taken by conventional wax-moulding presses, you gain a dividend of definite value in these days of high construction costs.



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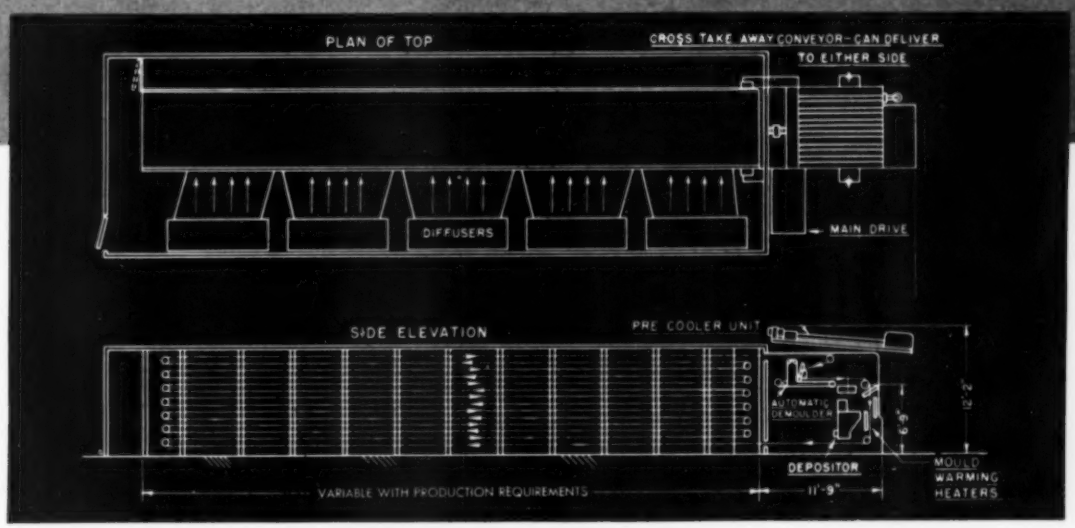
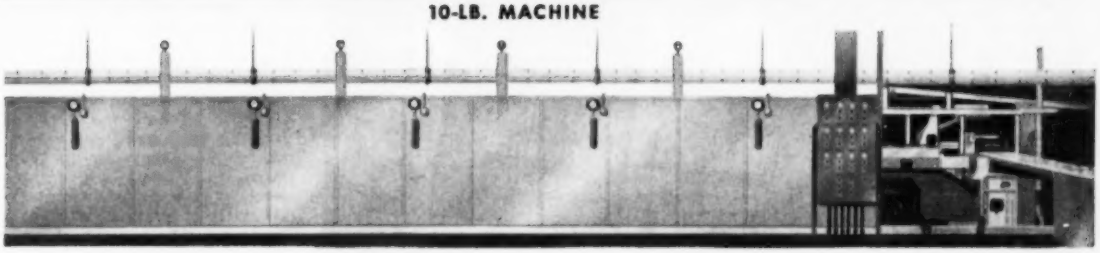
your products?



10-LB. MACHINE



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- **Cut labor approximately 5 times**
- **Increase production**
- **Save valuable floor space**
- **Obtain outstanding product quality**

WITH THE GREER AUTOMATIC WAX MOULDING MACHINE

Greer Engineers are ready to work with you on applying these continuous-production machines to your plant facilities. Ask for more information . . . there's no obligation, of course.

Industries J. W. GREER COMPANY

Main Office and Plant: WILMINGTON, MASS.

GREER

Who's Building . . .

coil cracking unit to handle the catalytic cycle stock. Still under construction is a vacuum distillation unit.

ANGLO-IRANIAN Completes Cat Cracker at Kent Refinery

The catalytic cracking plant at Anglo-Iranian Oil Company's new 80,000-barrel-a-day Kent refinery, south of London, has been completed and is scheduled to be commissioned shortly. This unit, like those recently commissioned at Anglo-Iranian's Llandarcy and Grangemouth refineries, will produce motor fuel.

These three cat crackers together process about 30,000 barrels a day of semi-refined heavy oil.

Construction Capsules . . .

The Shell Company of Australia, Ltd., has completed its $280 million refinery at Geelong, Australia, 36 miles from Melbourne. Projected annual capacity is 25,000 barrels a day.

Commercial Solvents Corporation has started production at its new ammonia plant at Sterlington, La., first privately financed postwar nitrogen facilities. The new units will double the company's production of nitrogen for fertilizer and industrial use.

Pennsylvania Salt Manufacturing Company has started production at its new electrolytic chlor-alkali plant at Calvert City, Ky. The plant is part of Pennsalt's expansion program that also includes a new synthetic ammonia unit at Wyandotte, Mich.

Colombia-Southern Chemical Corporation plans to construct its first ammonia producing facility at Natrium, W. Va., where it will use hydrogen from its electrolytic chlorine-caustic plant at that site. Production of ammonia is scheduled to start late in 1954.

Shell Chemical Company has started construction of a new glycerol and epon resins plant at Norco, La. Completion is scheduled for late 1954.

The Solvay Process Division of Allied Chemical and Dye Corporation has announced plans for the construction of a plant for the production of chloroform, methyl chloride, methylene chloride and carbon tetrachloride at Moundsville, W. Va.

The Standard Oil Company (Ohio) has placed a new alkylation plant on stream at its Toledo, Ohio, refinery. It took one year to build the plant, which was placed in operation at a cost of $3 million. Arthur G. McKee & Company was the primary contractor and responsible for the mechanical design.

Standard-Vacuum Refining Company of South Africa, Pty., Ltd., has scheduled initial operation of its new Durban, South Africa, refinery for early next year. First test runs will probably get under way shortly after the first of the year. The new refinery, first in South Africa, has a capacity of about 15,600 barrels a day, and includes catalytic cracking and reforming facilities.

Delta Refining Company, wholly owned by Missouri Farmers Association, has opened its newly expanded and modernized refinery at Memphis, Tenn. The refinery capacity has been increased from 4000 to 6000 barrels a day. On stream is a 2700-barrel-a-day Thermofor catalytic cracking unit.

Brazil's National Petroleum Council is planning a plant for the production of nitrogenous fertilizers near the Cubatao refinery, now under construction on the outskirts of Santos. The government has made an initial grant of funds for the project, and equipment has been purchased in Germany. At the same time, studies are now being made for a possible sulfur recovery plant to be built in conjunction with the new 45,000-barrel-a-day refinery.

Bay Petroleum Corporation last month announced its intention to close its 6000-barrel-a-day McPherson, Kan., refinery. The company's newly enlarged and modernized refineries at Denver and Chalmette, La., will suppy Kansas and Nebraska customers.

Standard-Vacuum Oil Company is reported negotiating with the government of India on the possibility of setting up a second refinery near Calcutta. Stanvac's first, under construction near Bombay, will go on stream in the middle of 1954.

Caminol Company will add a new polymerization unit to its Hanford, Calif., refinery as part of a $200,000 expansion program. The plant has a 1000-barrel-a-day cracking unit.

Oronite Chemical Company has approved first-stage construction plans for a multimillion dollar plant for the commercial production of isophthalic acid (m-benzene-dicarboxylic acid) on a large scale. Site for the plant has not yet been selected.

R. A. Goodall, an Ogallala, Neb., oil op-

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This new instrument serves to determine and record the specific gravity of liquids in the same manner as the standard Arcco-Anubis liquid gravitometer.
*In addition to these features, a controlling mechanism is provided, which may be pre-set to operate the pipe line, refinery, still and plant control valves to any specific gravity range required in blending two or more finished products.
Temperature corrected, this extremely accurate instrument is adaptable to high pressures and is available with internal parts of stainless steel for use with corrosive liquids. Send for bulletin No. 111 A.
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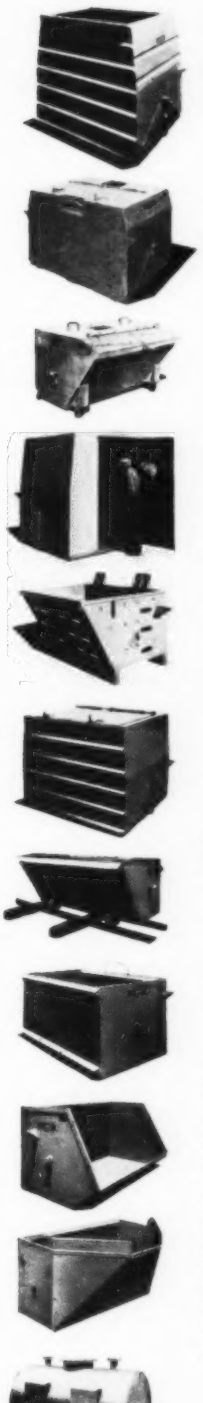
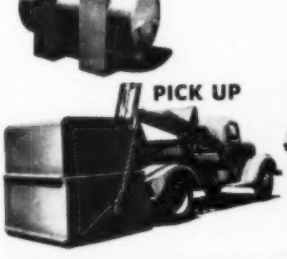


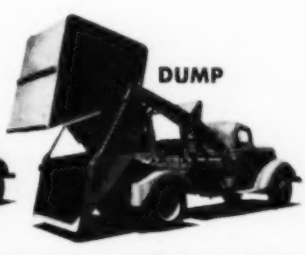
You will Dump High Costs, too..

. . . when you install the Dempster-Dumpster System of Bulk Materials Handling

Manufacturers over the nation have learned to eliminate the costly and inefficient method of handling bulk materials with conventional dump trucks, drivers and loading crews. You can equip one truck with a hydraulically operated Dempster-Dumpster. Then, inside or outside buildings at convenient accumulation points, you simply place detachable Dempster-Dumpster Containers, in capacities up to 4 times that of conventional dump truck bodies, with each designed to suit the materials to be handled—be they solids, liquids or dust . . . hot or cold . . . bulky, light or heavy. Containers shown at left, all handled by one Dempster-Dumpster, are only a few of the many available or that can be built to meet your needs. The Dempster-Dumpster, operated by only one man, the driver, serves scores of containers . . . one after another, as shown below.

You eliminate trucks standing idle. You eliminate re-handling of materials. You eliminate loading crews. You increase efficiency, sanitation and good plantkeeping with this Dempster-Dumpster System—the lowest cost method of bulk materials handling ever devised. Write to us for complete information. Manufactured exclusively by Dempster Brothers, Inc.





THE DEMPSTER DUMPSTER SYSTEM

DEMPSTER BROTHERS, 5113 Dempster Bldg., Knoxville 17, Tennessee

PROGRESS today in the power, processing and construction industries frequently depends upon new and varied types of heavy metal equipment.

Designing and building this equipment has long been an Alco specialty. From Tulsa to Trieste, from Pittsburgh to Palembang, Alco products ranging from 4-in. welded steel pipe to mammoth pressure vessels are giving outstanding service in all types of industrial installations.

This wealth of experience—applied by skilled engineers and craftsmen working with modern facilities—enables Alco to design and fabricate heavy equipment to meet rigid specifications.

Select your toughest heavy-equipment problem —then send it to your nearest Alco Products Sales Engineer. He'll quickly show you how Alco can produce the answer you've been looking for.

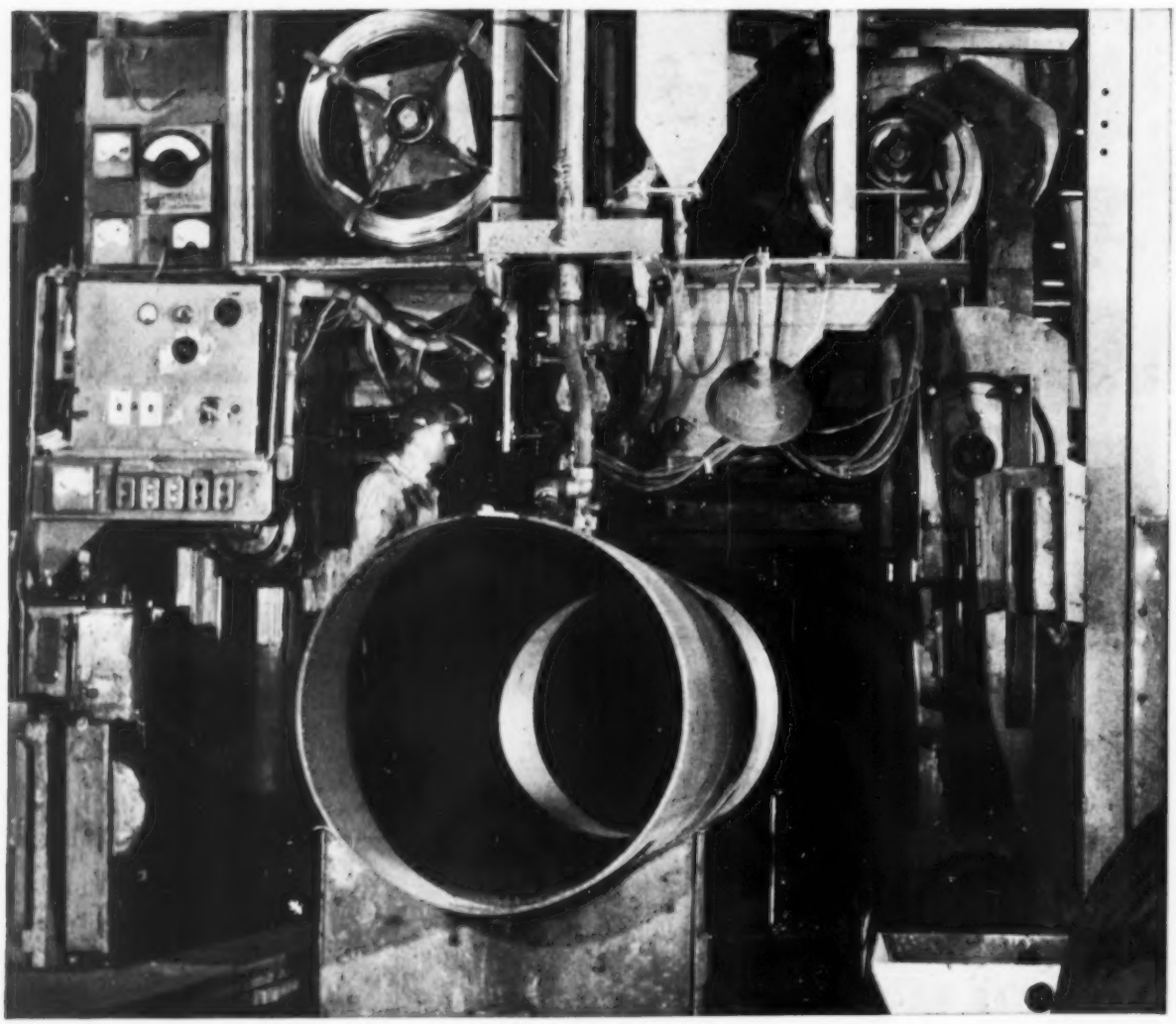
Alco Products Sales Offices are located in New York, Chicago, Dunkirk, Los Angeles, Kansas City, Houston, Tulsa and Beaumont.

Alco speeds progress in

Answers to

Alco

ALCO'S MODERN PRODUCTION FACILITIES, designed to handle economically many difficult metal-fabricating operations, include this automatic submerged-arc welding machine. Welds made on this machine must pass the most rigorous leak tests ever devised for commercial welding.



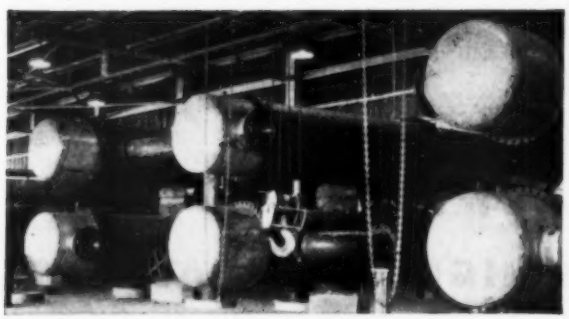
power and petroleum, chemicals and construction, with...

New Industrial Problems

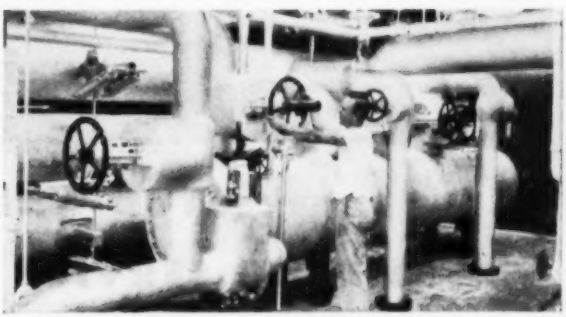
ALCO

ALCO PRODUCTS DIVISION

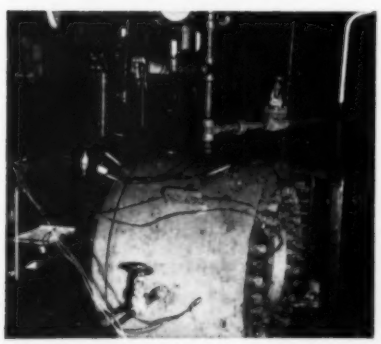
AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, NEW YORK



CUSTOM-BUILT HEAT EXCHANGERS ready for final piping in Canadian Chemical Company, Ltd.'s $55 million plant now under construction near Edmonton, Alberta. These units are among the more than 200 special reboilers and heat exchangers being supplied to the new Canadian plant by the Montreal Locomotive Works, Ltd., an Alco affiliate.

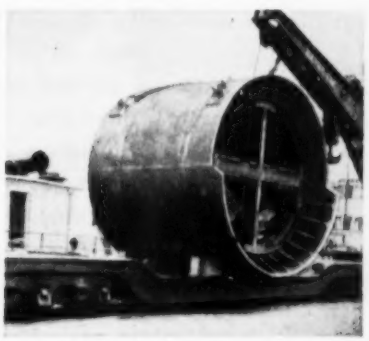


ALCO FLEX-TUBE EVAPORATORS incorporating many new features help boost efficiency at Carolina Power and Light Company's new 150,000 kw plant at Goldsboro, N. C. These specially designed Alco units produce vapor containing one part per million or less of mineral solids. Make-up to the system has been found to be less than one-half of one per cent.

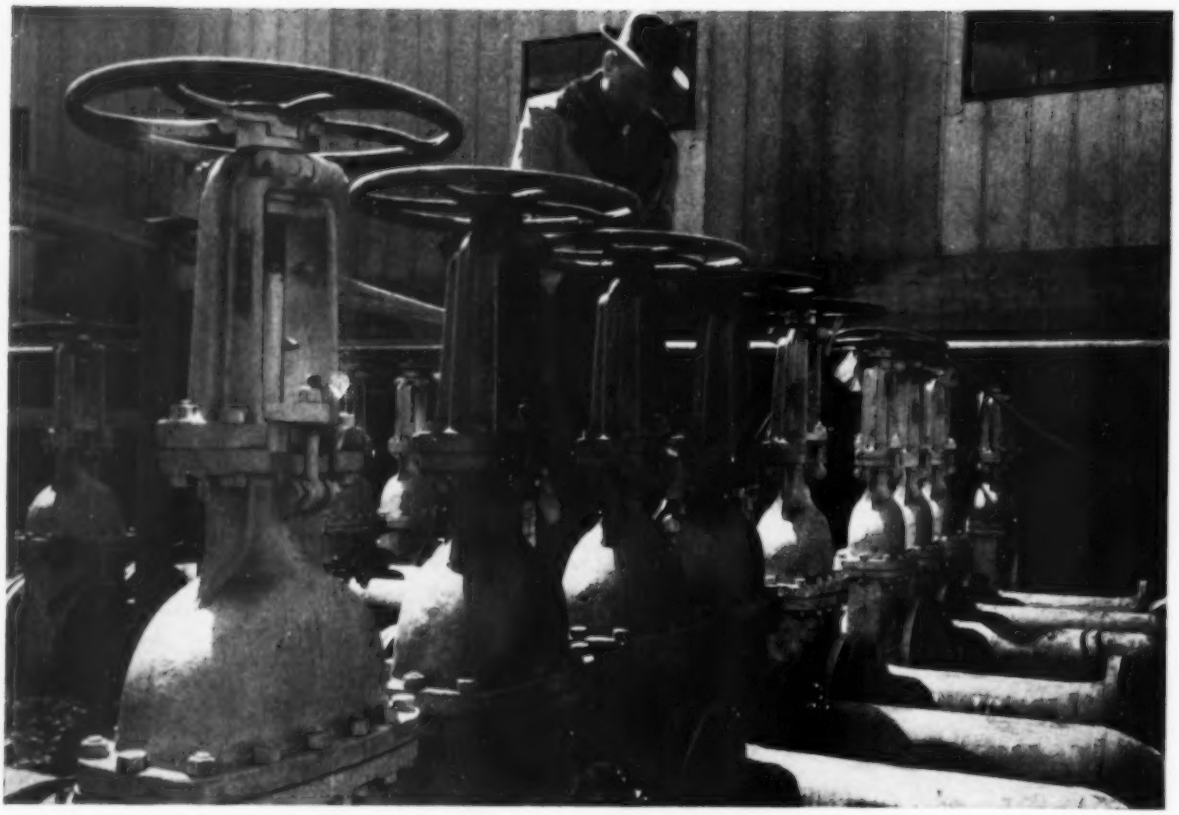


NEW HIGH-PRESSURE CLOSURE, shown here during high-temperature tests, is typical of the many heavy-equipment improvements developed by Alco engineers for service throughout industry. (Reprints of article, "Engineering Development of Alco's New High-Pressure Closure," available upon request.)

ALCO WELDED STEEL PIPE was furnished for the chilled water lines in the U. S. Government's new $4½ million walk-through tunnel, part of a Capitol Power Plant improvement project, now under construction at Washington, D. C. The 30-in. main lines (on tunnel floor) total about 9,280 ft., branch lines about 1,200 ft.



GIANT TUNNEL SHIELDS illustrate the variety of special heavy-metal equipment designed and fabricated by Alco for power, petroleum, chemical and construction companies the world over. Other items built by Alco to meet strict specifications range from tar stills to stripping towers, cement kilns to jet-engine containers.



STUD-AND-NUT TEAM
GIVES LONG SERVICE AT HIGH TEMPERATURES

Looking for economical fasteners? The kind you can use for long periods of time in high-temperature, high-pressure bolting jobs? Then it's time to use the Bethlehem Continuous-Thread Stud, together with two Bethlehem Quenched Nuts.

This popular stud-and-nut team is economical because it resists premature failure caused by high temperatures and pressures. It pays for itself over and over again by effectively minimizing down-time.

We shall be pleased to answer any question you may have about the use of Bethlehem Studs and Nuts in difficult bolting applications. Your letter, addressed to the nearest Bethlehem office, will receive prompt attention.

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BETHLEHEM STEEL

BETHLEHEM CONTINUOUS-THREAD STUD—*Has no point of thread run-out, thus eliminating that source of stress-concentration. Instead, stresses are distributed along full working length of stud. Made from carbon or alloy steel. Comes plain or heat-treated.*

BETHLEHEM QUENCHED NUT
Made from .40 to .50 carbon steel. Forged and extruded in forming die, then quenched and tempered. Develops the full strength of any stud or bolt.

Bethlehem supplies every type of Fastener

WHO'S Building . . .

erator, plans to build a $1 million gasoline plant in the Little Beaver Creek field in northeastern Colorado, to operate on about 10 Mmcf of gas a day. Goodall is negotiating with Continental and Lion for association with him in the gasoline plant.

CANADIAN FIRM Will Build Portable Gas Processing Units

The first portable gas process plants ever to be constructed in western Canada will be built within the next several months by Canadian Palmer Stendel Oil Corporation. Construction of the plants is a result of agreements entered into by the company with California Standard Company, a subsidiary of Standard Oil Company of California; Canadian Gulf Oil Company, a subsidiary of Gulf Oil Corporation; and others. Cost of the project is estimated at $1 million.

Share owners of Canadian Palmer Stendel have been advised of these developments. At their annual meeting they will be asked to vote approval of the financing and to authorize changing the name of the company to Progas of Canada, Inc., a Delaware corporation.

Major advantages of portable equipment are mobility, relatively low cost of construction and operation, plus the fact that the initially installed unit can easily be expanded into a larger one if it is found desirable to make it a permanent installation in a particular field.

GERMAN REFINER Starts Operation of New Cat Cracker

A Houdriflow catalytic cracking unit has been placed in operation at the new Ligen-Holthausen refinery of Gewerkschaft Erdoel-Raffinerie in West Germany. The unit forms the principal processing section of the new 10,000-barrel-a-day refinery which was built by the German producing companies, Wintershall A. G., and Gewerkschaft Elwerath, for the processing of Gergsdorf and Emlichheim crudes.

In the processing plant employed, a Lummus coker forms part of the feed preparation section for the Houdriflow unit.

McCOLL Plans Increase In Edmonton Refinery Capacity

McColl-Frontenac Oil Company plans to increase capacity of its 5500-barrel-a-day refinery at Edmonton, Alberta, Canada, to 11,000 barrels a day. The increase is said to be necessary to meet the demand in Western Canada. Details as to type and size of the new refinery units are not yet available. Completion is expected in late 1954 or early 1955.

GERMAN FIRMS Will Build Petrochemical Plant

Construction is scheduled to start soon in the Wesseling area, Germany, between Cologne and Bonn, on a new plant for the manufacture of polyethylene and ethyl benzene. The plant will be the first of its kind in Western Germany. The installation will utilize gases from a nearby oil refinery. The enterprise is being entered in the trade register under the name of Rheinische Olefinwerke GmbH. It is a mutual foundation of Badischen Anilin & Sodafabrik AG, Ludwigshafen, and German Shell AG, Hamburg. Production will start in 1955.

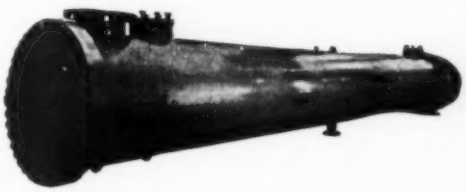
HAVING TROUBLE PUMPING HEAVY OILS?
CONCERNED ABOUT LOSSES RESULTING FROM VOLUME SHRINKAGE AT LOW OIL DELIVERY TEMPERATURES?
...THEN INSTALL
Paracoil
TANK SUCTION HEATERS
TO SOLVE YOUR PROBLEMS

TANK SUCTION HEATER INSTALLATION
The shell is open at the inside end. The oil moves across the heating tubes as it passes through the shell to the suction connection outside the tank.

In Bulk Oil Terminals and Refineries the world over Paracoil Tank Suction Oil Heaters are licking the problem of economically preheating heavy viscous oils to permit their withdrawal from storage tanks. They are also preheating the lighter grades of fuel oils to their proper delivery temperatures to avoid the costly volume losses incurred when such oils are sold at low temperatures.

WITH PARACOIL TANK SUCTION OIL HEATERS

- You Heat Only The Oil That Is Being Withdrawn From The Tank. (Thus radiation losses resulting from heating entire tank contents are eliminated.)
- Overall Steam Consumption And Heating Costs Are Held To A Minimum.
- Heater Tube Bundle Can Be Withdrawn For Inspection And Cleaning. Breaking of oil suction line not necessary.
- All Piping Connections And Gaskets Are Outside The Tank.
- U-Tube Design Permits Free Expansion And Contraction Of Tube Bundle. Either high or low pressure steam can be used as the heating medium.



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Our extensive stocks of tubing and pipe enable us to make quick deliveries to meet your immediate requirements.
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SPEED UP DELIVERIES AND CUT OIL VOLUME LOSSES WITH PARACOIL TANK SUCTION HEATERS

In addition to the Paracoil Tank Suction Heaters, we also design and fabricate Line Type Discharge Heaters of any capacity. Illustrated is a Paracoil Straight Tube Type Fuel Oil Heater for bulk station service—capacity 2,000 gallons per minute, No. 6 oil, 100°F to 160°F, steam at 15 psig. Weight 12 tons.

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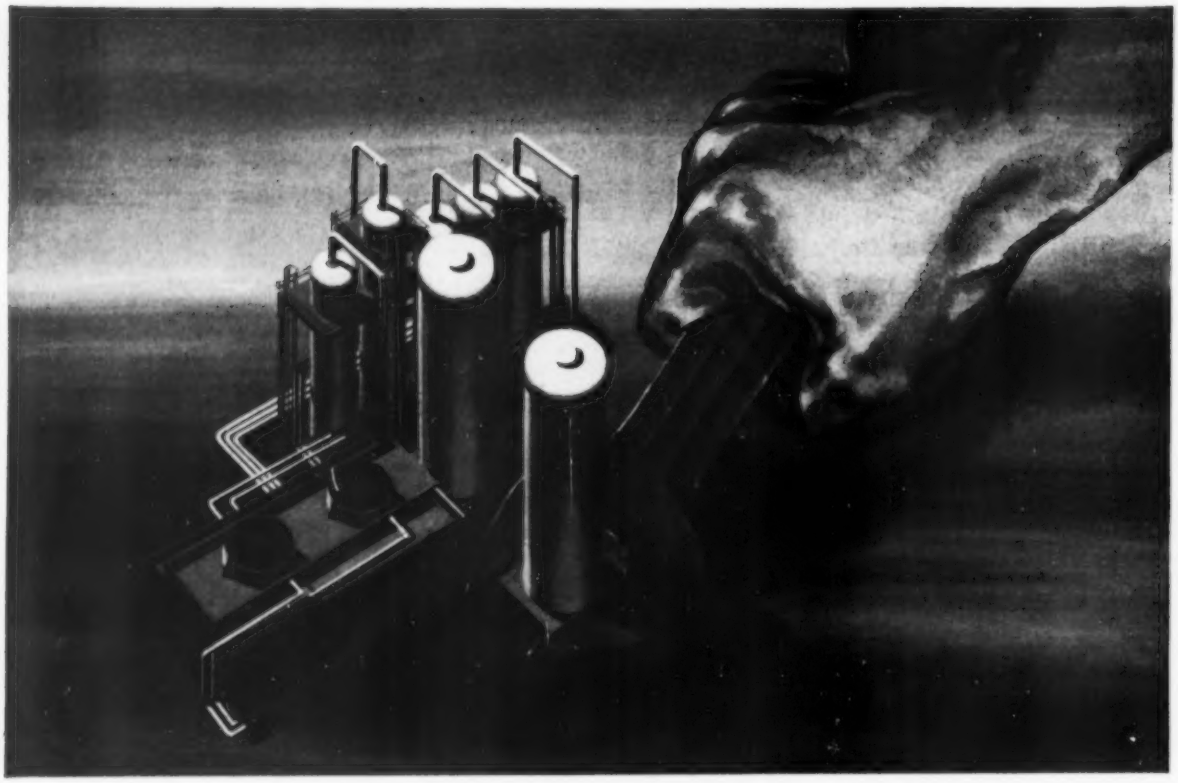

How To Bolt Down Profits In New Production Planning

Has a tough operating problem threatened your output schedules? Here's how one producer licked his problem before it started.

For a new process this refinery required economical heating, under vacuum, of highly corrosive crude that was to be pumped into a fractionator for further processing.

SOLUTION: Crude oil feed tanks of stainless-clad steel, vertical type, externally braced. Heat is provided by an internal steam coil of solid stainless steel. Vacuum operation is withstood successfully by clad steel tank design. Flued openings and manholes provide for easy inspection and maintenance. Inner stainless surfaces resist corrosion; carbon steel backing and steel stiffening rings insure rigidity and strength with maximum economy. Result: economical heating of crude oil to proper temperature. Corrosion problem eliminated by equipment with low first cost and long service life. Maintenance costs reduced to a minimum.

This unit increased this company's output and profits. It was ideal for the job. How was this advance achieved? Through close coordination between engineering staffs of progressive Equipment Builders, process engineers, designers and materials suppliers.

Such bonus attention is a practice with progressive Equipment Builders. They turn to Lukens regularly for its knowledge of materials as well as its wide range of low-cost clad steels.

Would you like such specialists to study your problem? We will send you their names. Write today explaining your need. Manager, Marketing Service, 404 Lukens Building, Coatesville, Pa.

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Meet Our **Authors** . . .

• CONTINUED FROM PAGE 196

Chemical Engineers (presently on the Public Relations committee); and National Research Council (presently chairman of the Fats and Oils committee).

In addition to these affiliations he is a member of over a dozen honorary fraternities and clubs. He has published 68 articles and books and holds 32 patents.

Born in Binghamton, N. Y., he received a B.S. degree from Colgate University in 1919; an A.M. degree from Columbia University in 1922, and a Ph.D. degree from Columbia in 1923.

Saunders

Uris

Saunders Offers Idea On Best Type of Executive

George M. Saunders, "*Live* Executives Are Best!" page 287.

Medical director of Socony-Vacuum Oil Company, Inc., since 1951, Dr. Saunders was born in Superior, Wis., and graduated from Harvard University Medical School cum laude in 1925. He has been with the Firestone Plantations Company, Rockefeller Foundation, Leonard Wood Memorial, and the Institute of Inter-American Affairs in South America. He served as a lieutenant commander in the Naval Reserve Medical Corps from 1944 to 1946. He is Associate Clinical Professor of Industrial Medicine, N.Y.U. Post-Graduate Medical School and Visiting Lecturer, Harvard School of Public Health.

Dr. Saunders was associate director of the Medical department of Monsanto Chemical Company and on the faculty of Washington University Medical School in St. Louis before joining Socony-Vacuum in 1950.

Uris Writes Paper For Management Section

Auren Uris, "You're Fired!!" page 296.

This author of several books, (the latest is "How to Be a Successful Leader," recently published by McGraw-Hill), has had considerable management experience as an editor at The Research Institute of America, Inc., New York. Uris has worked in industry, owned his own business, and is a frequent magazine contributor on subjects of management, management development, and human relations.

New **BOOKS** . . .

Plastics Material

1953 Modern Plastics Encyclopedia and Engineer's Handbook, Breskin Publications, 575 Madison Avenue, New York 22. Distribution limited to subscribers to *Modern Plastics;* details available from the Circulation department of Breskin Publications.

This thirteenth annual edition of the standard reference work on plastics materials and production methods, like its predecessor, is a working guide to the selection and use of commercially available plastics materials in the manufacture of products and parts. The 943-page volume incorporates basic data on the many new materials and processing techniques that have been developed during the period between editions. The new edition includes special chapters on reinforced plastics, plastic film and sheeting, and vacuum forming methods, reflecting important growth trends within the industry. Other additions are the fully revised series of charts covering the properties and processing peculiarities of plastics resins and compounds. One of these is a 16-page solvents chart that details the properties and uses of 257 solvents for plastics; another is a bibliography on properties and testing.

Other major sections of the volume are "Engineering and Methods," "Resins and Molding Compounds," "Chemicals for Plastics," "Fillers and Reinforcements," and a "Buyers Directory."

Jelinek Joins Columbia

Robert V. Jelinek has resigned his position with the Development division of Standard Oil Development Company to accept an appointment as assistant professor of chemical engineering at Columbia University.

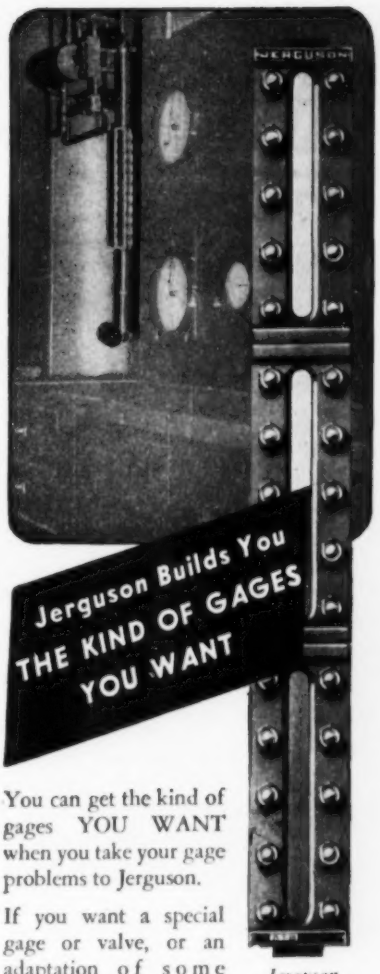
Caltex Gets New Offices

California Texas Oil Company, Ltd., has moved into new quarters at 380 Madison Avenue, New York.

Chemicals Wanted

The National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only one gram quantities, please inform the Registry.

Acenaphthalene
Butadiene monoxide
1,4-Dibromo-2-butyne
Cyanogen
Boron tribromide
2,2-Dichloroethanol
3,4-Dimethylpyridine
tert.-Butyl amine
3-Hydroxy-4-hexenal
2-Ethyl-4-methyl-1,3-dioxolane
2,4,5-Trimethyl-1,4-hexadiene
1,2,4,5-Tetramethylbenzene
Tetraphenylethylene oxide
Hexaethyldisilane
1,2-Ethanedithiol
para-Chlorobenzyl vinyl ether
Acenaphthalene
1,2-Diaminocycloheptane



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You can get the kind of gages YOU WANT when you take your gage problems to Jerguson.

If you want a special gage or valve, or an adaptation of some standard one for a particular need, we'll give it to you. Our technically trained engineers have the ability, the know-how and the WILLINGNESS to pitch in and help you solve your problems.

Standard gages and valves, of course, are available at Jerguson's in the most complete and varied line offered anywhere.

Chemicals that raise havoc with ordinary gages can be handled with Jerguson special material and lined gages.

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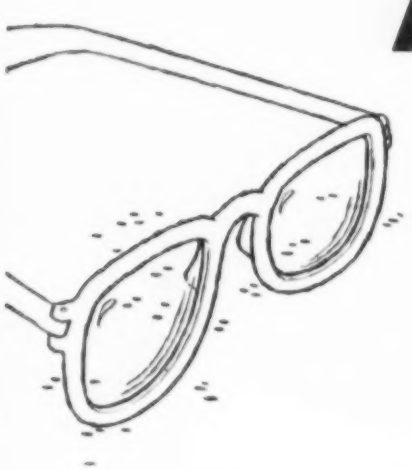
GRAVER CONSTRUCTION SERVICE LOOKS

beyond the "specs"



WHETHER your business is steel, chemicals or petroleum, Graver Construction Company is prepared to do the complete job for you . . . from foundation to erection, to installation of machinery, special equipment and furnaces.

GRAVER HANDLES ALL construction phases, including engineering to your precise needs and specifications.

However, Graver service includes more than meeting specifications. Years of proved performance have earned Graver a reputation for ingenuity in solving challenging construction problems. This, plus an unusual flexibility, means no job is too tough to handle —all are welcome, big and small alike.

Simply contact your nearest Graver office, and an engineering representative will be available to discuss your construction problems with you.

YOU ARE CORDIALLY INVITED
to visit us at suite 1700, Conrad Hilton Hotel, Chicago. November 9 through 12.

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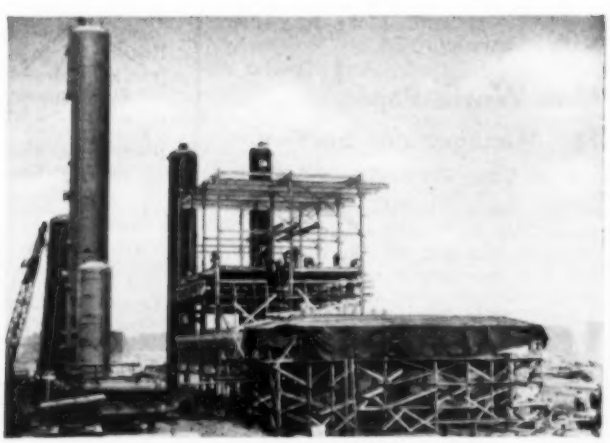
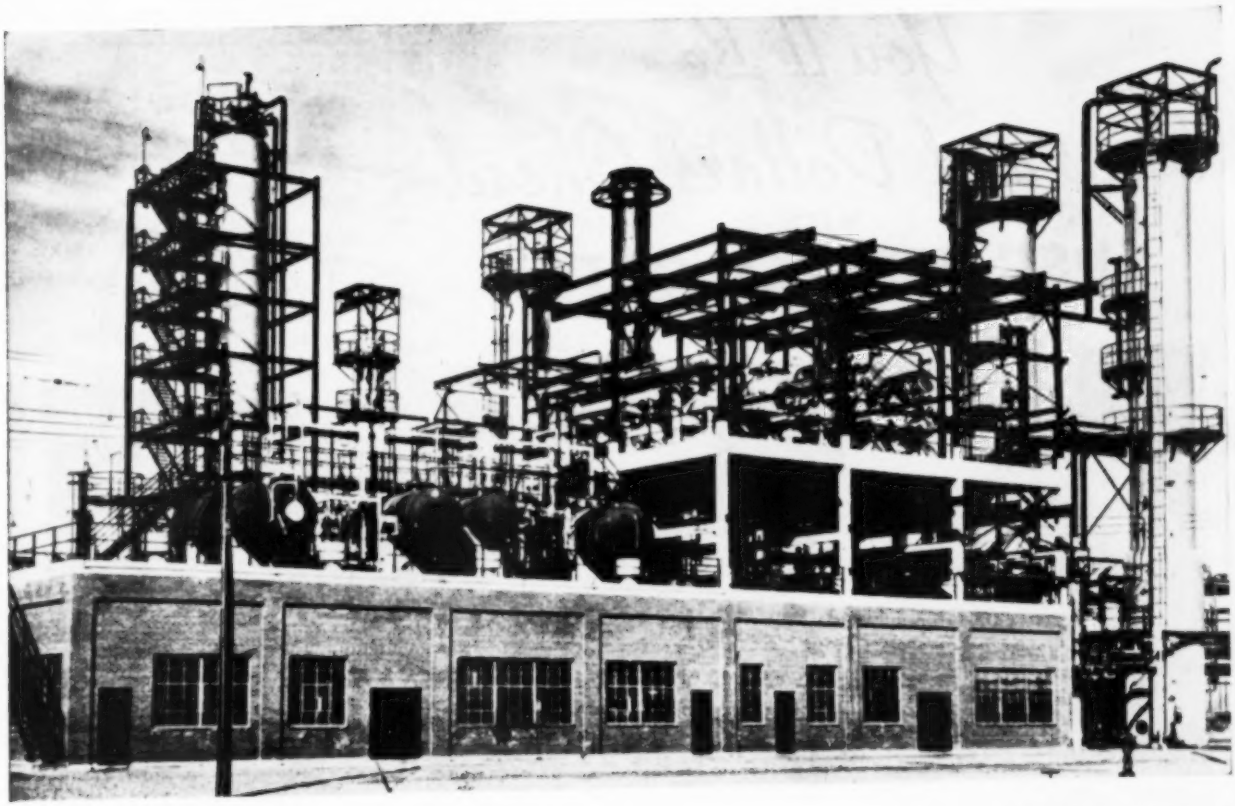
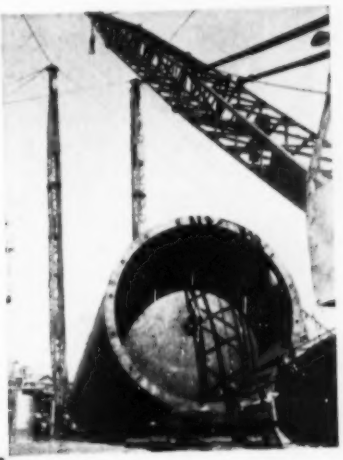
CONSTRUCTION DIVISION







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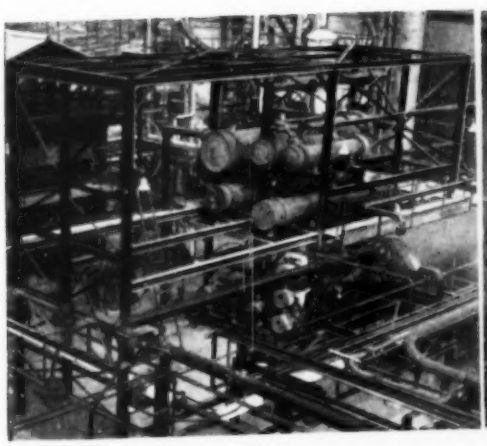

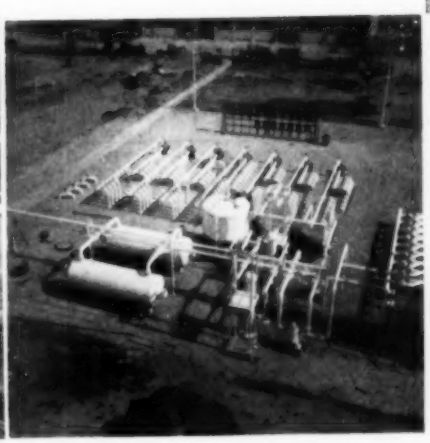

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WITH

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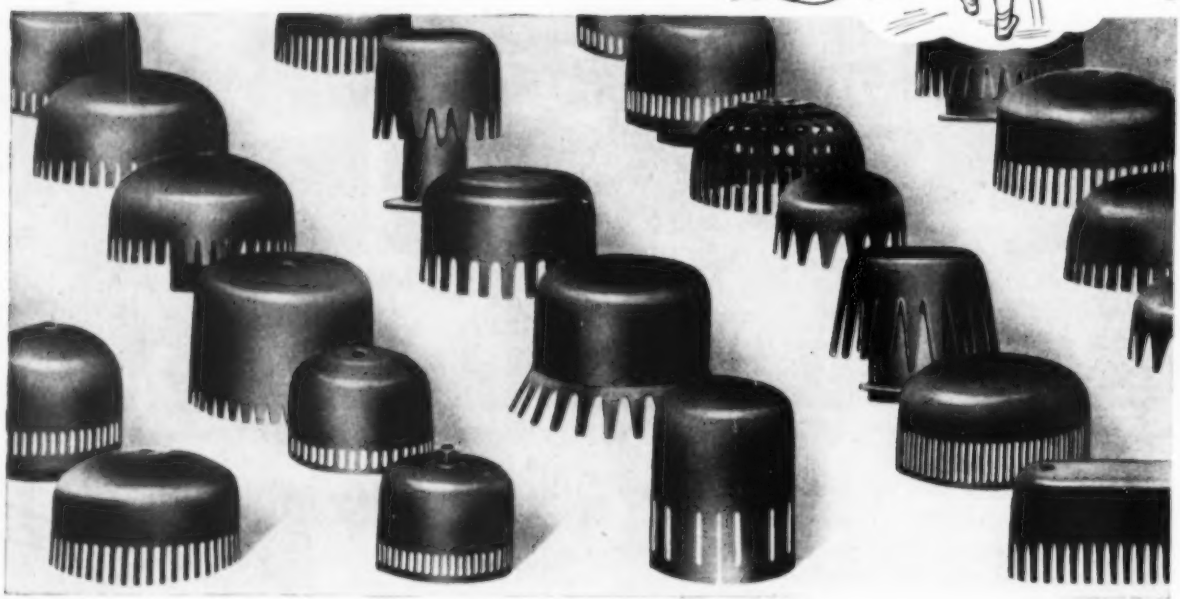

300 Standard Styles of Caps & Risers *Promptly* Furnished *Without Die Cost*

With dies on hand for 300 styles of bubble caps and risers, The Pressed Steel Co. saves many customers not only the cost of dies but also design and delivery time. Check PSC and you can be days and dollars ahead.

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George M. Saunders, M.D., Medical Director, Socony-Vacuum Oil Co., Inc., New York

DURING THE LAST half century, America has grown from an agricultural country to the greatest industrial nation that the world has ever known. The future success of or country and of our way of life depends, to a great degree, upon our industry, our industrial manpower, and upon the wisdom, the competence, and the vigor of the executives who manage our industry.

It seems obvious that the physical as well as the mental health of those responsible for directing our industrial machinery may have a profound effect on its success or failure. Many big companies have come to realize that among their most valuable assets are their executives, and during the past 20 or 30 years the concept of executive health programs has developed.

Results of executive health surveys indicate that about 60 percent of the executives have one or more significant abnormalities, many of them correctible. Also, an average of about 40 percent of the executives state that abnormal conditions were revealed of which they had previuosly been unaware.

The purpose of this article is to explore some of the reasons for executive health plans, to present some of the methods, to discuss some of the findings, and to attempt to assess their value. I should like to state that any opinions or recommendations expressed are my own, and are not necessarily held or accepted by my company.

The Modern Executive—The popular concept of the big business executive is that of a harassed, portly, gentleman sitting behind a polished desk equipped with rows of push buttons and several telephones. He pushes buttons, issues orders, dictates memos, dashes off to attend a meeting, or to make a speech, and then may have to stay up until late hours at a banquet or a dinner party. This popular picture is at least partly true.

The "Dictionary of Occupational Titles" defines executives as those who exercise responsibility for the planning, determination, and direction of policies and operations. A simpler definition might be those who devote the major part of their time to planning for and directing the activities of others. It should be remembered that in addition to having to carry heavy responsibilities, executives have many of the same strengths and weaknesses, problems and trials, the rest of us have.

A good question to answer is how important executives are numerically. A recent survey of 82 companies showed that only a small fraction of 1 percent were titled officers, major or top executives, while about 10 percent were classed as managers, department heads or supervisors. The larger the business and the number of employes, the smaller was the proportion of managerial positions and hence the competition for such positions is greater in the larger companies.[1]

Over-all, in our industrial labor force of about 50 millions, there are, perhaps, 2½ million who may be classed as executives or managers. The tremendous importance of the competence of the executive group becomes apparent when it is remembered that the effectiveness of one of them is reflected in the activities of dozens or even thousands of workers at the operator level.

The American business executive is a new species of being, generated in the last half century, and we are only just beginning to learn the desirable qualities of mind, body and emotion he should possess in order to function efficiently and not to break under the strain. At the beginning of this century, there was no big business in America. There were many small plants, factories, mines and mills, generally owned by small groups who did their own managing. The rapid growth of our industrial economy required the development of executive management on a large scale in order to operate the business for the owners, usually thousands or tens of thousands of stock holders.

There are many valid reasons why owners and management should have great concern for the health of their present and potential executive group. Industrial health programs whose basic objectives are health promotion and hygiene and not finger bandaging, have proven their worth in increased production, efficiency and morale of workers generally.[2] The basic principles apply not only to the daily paid workers, but also to top levels of management because the latter have not only most of the health problems of the workers, but, in addition, others of a special nature which are inherent in the direct and indirect tensions of their daily lives.

Problem of Aging—The problems of aging begin to show up in the executive group because their ages range from about 40 to 60 years with the majority being more than 50 years old. Recent life insurance figures show that the average life expectancy of industrial workers, 50 years old, increased five years between 1911 and 1949 (from 17 to 22 years).[3] The executives have probably experienced an equal increase and there has doubtless

been a concomitant rise in the prevalence of degenerative and neoplastic diseases.

There are special stresses and strains which are exerted on the executive which demand peculiar qualities of resistance for survival. The big business executive today works in a world which has expanded tremendously and is no longer bounded by the limits of the factory or the city but by the ends of the earth.[4] One minute he may be discussing the trends in fuel oil prices with a marketing analyst, the next talking to a producing chief in Venezuela, and after putting the finishing touches on a speech he has to make on the West Coast, is on his way to the airport to make the 5 o'clock flight.

The intrinsic qualities which make men able executives, such as imagination and driving energy, are the very ones which may lead to disaster. A recent article in *Look* magazine entitled "Your Next Promotion Can Kill You," indicates that men promoted to positions beyond their inherent capacity to fill adequately without strain may be headed for the final crackup.[5] Man should live and work within his resources.

The most important feature of executive health programs, and perhaps the one of most value, is the system of careful periodic health inventories which are made to assess the physiologic and emotional condition with special reference to the demands of the job. They should be part of any selection program for promotion. It may be possible in many cases to save a man from over-promotion, thereby protecting not only his health but also the interest of the company and the stockholders.

The question is sometimes raised as to whether we are justified in a democracy in having for executive groups special types of health programs which may be more extensive and thorough than those offered to daily paid workers. I think we are justified for several reasons. For example, it is well known that pilots of commercial airlines are required to undergo a searching physical examination at frequent intervals. One certainly would not suggest it was undemocratic to give one type of examination to the pilot and a much less thorough examination to the janitor who works at the airport. The errors and mistakes that an executive may make because of ill-health may not endanger the health or lives of others, but certainly, his errors may endanger the jobs of hundreds or possibly thousands of his co-workers.

Many Health Plans—There are many different plans for promoting executive health. There is no common pattern, except that almost all of them are based upon the periodic health inventory. Among many variables to be considered are: The definition of eligibility, whether the program is voluntary or compulsory, the periodicity and the responsibility for performing the examination, their scope, methods of reporting results, the time required and the cost.[6]

Standards for eligibility differ. In some companies only the highest management levels are included, such as the president, the chairman, and the directors. In perhaps half the companies, examinations are offered to lower management levels, including depart-

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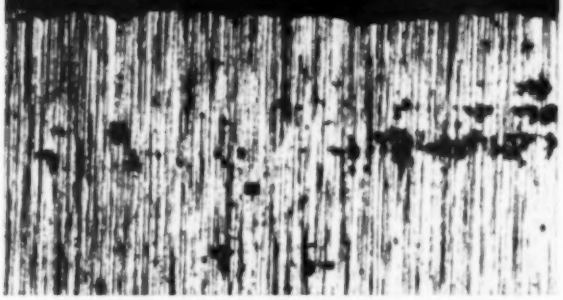
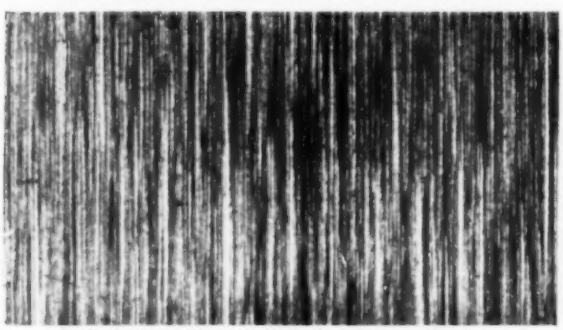


Pitting with conventional treatment at 18 magnifications



Lack of pitting, Dianodic Method, at 18 magnifications

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FOR years, industry has sought a method of chemical treatment that would provide *complete* protection against corrosion, pitting and scale in cooling water systems. Many present day methods for corrosion prevention do effect some decrease in metal loss, but unless excess treatment concentrations are used, localized attack in the form of pitting continues with ultimate metal failure.

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ment heads, superintendents and foremen. The General Motors program includes all "senior executives" of which there are said to be over 6500 at the present time.[7] In some instances definition is made according to salary level.

Compulsion is usually avoided, and with few exceptions participation is entirely voluntary. In two large companies, more than 95 percent of all eligible executives take advantage of health examinations on a voluntary basis. Although compulsion is the exception, there are certain situations in which an executive should be required —in the interest not only of himself but of the stockholders—to submit to a careful and searching examination; for example, when it is proposed to promote to a high echelon of management an individual who will be assuming greater responsibility. This is particularly true in older people among whom cerebral changes or diseases of the cardiovascular system may be present.

If it were once understood among the lower echelons of management that promotion to higher level was dependent upon proof of satisfactory health, then there would be no argument when the examination time comes around.

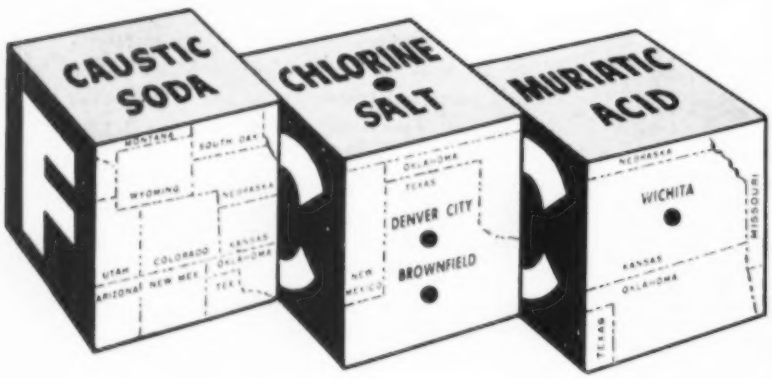
Regarding the frequency of the examination there are various schools of thought. Although the majority of plans recommend annual examinations, in some they are offered less frequently, while in others it is recommended that the older executives and those with some impairment should be examined more often than once a year. In general, I believe that the periodicity should be determined by the age of the individual, the special stresses and strains of his job and his physical and mental condition.

There is no uniformity in the designation of examining physicians or clinics. Some companies refer their executives to clinics or individual physicians. Others with well-established medical departments, staffed by competent personnel, perform their own physical examinations. It is my feeling that this is preferable, providing that the medical departments are adequately staffed and equipped with modern diagnostic tools. The company physician should be in a better position to be familiar with the work demands of the executives and with their temperaments, personalities, and their outside activities.

Discussing Findings—Once the examination is completed, I believe that when the company has a competent medical advisor, he should receive the results of examinations and should discuss them with the executives in question. If there are any findings which indicate a restriction or a change in activity, permission should be requested of the individual to discuss the situation with his superior officer. During several years' experience with executives I have always found that they are only too glad to have their condition discussed with some high ranking official in the company if it is recommended by the examining physician.

The thoroughness of health examinations varies considerably with the time taken and the cost. However, their ultimate value to the individual and to the company probably is directly proportional to their completeness. Each examination should be complete enough to permit the examiner to say with confidence that he knows the condition of the various body systems,

new sources for basic chemicals



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how they are functioning as separate systems and a coordinated whole and what abnormalities are present.

The findings revealed by health surveys of executives vary somewhat from group to group, but certain facts are evident. Defects of function or structure are found in about 60 percent of executives, and an average of about 40 percent of them state that abnormal conditions were revealed of which they had previously been unaware. A list of many of the abnormal findings which have been reported would include those shown in Table 1:[4, 6, 7, 8, 9]

Many of these conditions may endanger future health and longevity and deserve some comment. One of the most common findings was that of overweight (20 to 30 percent). Life insurance figures show that among overweight individuals who were accepted for insurance as substandard risks, the subsequent mortality was 50 percent greater than among those of normal weight. This excess mortality was largely the result of chronic diseases of the heart, cerebral hemorrhage, chronic nephritis, diabetes, cirrhosis of the liver and gall stones.[10] Reducing lowers the mortality. In this connection, in our company's executive dining room in New York, during the past several months we have been listing in the luncheon menus the caloric values of the food items. This has resulted in much lively conversation and probably several tons of weight loss.

TABLE 1

Condition	Percent of Group
Overweight	20-30
High blood pressure	7-15
Heart disease	2-10
Peptic ulcers	4- 5
Gastric ulcers	10-12
Neuroses, anxiety and tension states	4-14
Vision defects—uncorrected	8-12
Rectal abnormalties including hemorrhoids and rectal polyps	6-14
Abnormalities of the prostate	4- 5
Pulmonary tuberculosis (arrested)	1- 6
Gall bladder disease	1- 2
Organic lesions including cerebral vascular accidents, Parkinson syndrone, multiple sclerosis	0- 1
Malignancies of large bowel	0- 2
Hernias	3- 4
Diabetes	1- 2
Arthritis of the spine	4- 5

High Blood Pressure—High blood pressure is common (7 to 15 percent). In many cases this represents true hypertension and in others it is a temporary condition, possibly a labile blood pressure, one easily stimulated to rise to high levels. In any event, therapeutic measures including counselling and guidance regarding physical and mental hygiene can often alleviate or delay the organic changes which may result.

Heart disease is found frequently (2 to 10 percent). This is not surprising, since it is well known that heart disease is the leading cause of death among males in the age groups of most executives. The types of heart disease found are usually either angina pectoris, coronary artery disease with occlusion or hypertensive and arteriosclerotic heart disease. It is not known for certain if heart disease is an occupational hazard of business executives. It is known, however, that emotions such as anger, fear, anxiety or pain may affect the heart profoundly, not only its action but the rate, the sounds, the electrographic tracing and the blood pressure. White has stated that certain symptoms of coronary artery disease are more often found in sensitive, mentally overworked and frequently robust, or stout professional and business men than in others.

However, the routine activity of persons in industry, business and the professions, if carried on in a sensible

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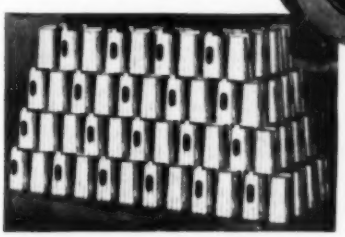
This Monel tube bundle used in an HF Alkylation Unit Dehydrator Reboiler is an excellent example of the use of Monel to resist corrosive chemical attack even at high operating temperatures.



These plugs for 2-inch plug valves used in hydrofluoric acid alkylation service were machined from Monel rod. No. 140 Monel Arc Electrodes are used for overlaying steel plugs in larger valves.

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Monel lined hydrofluoric acid regenerator column with 1/16" minimum lining of Monel. The two Monel grids are for holding the Raschig rings.

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It does not acquire a scale when exposed to anhydrous HF which makes it especially useful for moving parts having close clearances, such as plug valves and pump rings.

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manner, neither initiates heart disease nor makes it worse if it is already present unless it is very severe or going through an active stage.[11] It is important to recognize true organic heart disease and to evaluate it for what it is worth. Many things can be done to slow the process and to prevent complications, and very often heart disease is not incompatible with a long, useful, and active life.

Abnormalities of the prostate are frequently encountered (4 to 5 percent). Prostatic hypertrophy may lead to obstruction. Solitary nodules should be regarded with suspicion as possibly cancer, and either benign hypertrophy or prostatic cancer may be successfully treated if discovered early.

Cancer Won't Wait—Cancer is the second cause of death among men of the executive age group and the examiner's index of suspicion should be high. Particularly to be sought are early signs or symptoms of cancer of the lungs, the stomach, the large bowel and the prostate. It is only with early detection and prompt and adequate treatment that cure may be achieved.

Diabetes is to be expected in perhaps 2 percent of executives and in many instances is discovered for the first time at the health inventory. The disease may be easily controlled by simple weight reduction and a sinsible diet with or without insulin and disabling complications prevented.

All gradations of neuroses may be encountered, from minor anxieties, insomnia, and "stomach trouble" to the more serious obsessional states. In most instances a frank discussion with a sympathetic and wise physician may correct the situation. In others, special psychiatric help may be needed. Sometimes all that may be required will be a change of scenery or an insistence that the long-delayed vacation be taken promptly. In some, a change of job may be indicated.

One condition which has a serious effect upon mental ability and which may go unrecognized for a long time is disease of the cerebral vascular system. Damage to the brain from arterial insufficiency, thromboses, or small hemorrhages may ont be readily apparent and yet may cause a complete change in personality, emotional stability and mental agility. The errors of judgment which may follow can be very costly.

There is no doubt that a careful, systematic plan of health promotion will return to the industry many times its cost. The early detection of disease or structural abnormalities may allow prompt cure or correction, and prevent serious and possibly fatal disabilities. Better health means better morale, increased efficiency and less time lost because of illness. These are the tangible returns which are to be expected.

This article is from a paper presented at the 6th Annual Industrial Health Conference in Houston, October 1-2-3.

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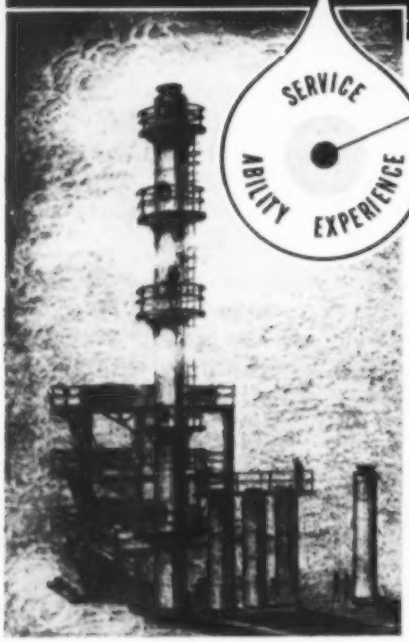

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As **MANAGEMENT** Sees It . . .

To discharge an employe by improper means is to invite repercussions in employe, community and customer relations.

You're Fired!!

You don't dismiss an employe with such harsh words, of course, but even the kindest language hurts badly unless you have a planned approach.

Auren Uris, The Research Institute of America, Inc., New York

"YOU'RE FIRED."

Harsh words? Definitely. Firing an employe involves a real emotional wrench at both ends.

Sometimes executives lie awake nights, trying to figure a way out: "Transfer him to another department? Shift him to a less demanding assignment?" Or, another much considered alternative: "I'll do it next week, next month, next year."

Semantics Makes It Tougher

Even the language adds to the problem. Just consider some of the words that are used to describe the action:

fire	discharge
dismiss	terminate
release	

Not a pleasant word in the lot—which is proper enough since the action is usually not pleasant. But it's just one more factor that builds the atmosphere of emotional shock.

The Constructive Approach

Nevertheless, the facts may require that you act. After you have weighed all the pros and cons, made every consideration you can think of, you may still decide on dismissal. Then, you must move so as to accomplish certain specific objectives.

You may have one of a possible variety of objectives in letting an employe go. It may be the enforcement of discipline, removal of a source of friction, elimination of substandard performance. Or the company's situation may require a reduction in personnel. Whatever the reason, you must handle the discharge in such a way as to—

- Minimize the impact on the employe you're dismissing;
- Eliminate as much as possible any repercussions which will affect customer or community relations;
- Retain or improve group morale.

They're not easy targets. Your human relations skills and general executive ability may have to be exercised to their fullest extent. But the potential returns make it worth while.

It's unlikely that you're ever going to *enjoy* the process of firing. But a planned approach can eliminate many of the headaches and heartaches.

Here is a step-by-step procedure which can guide your actions:

1. Fair Warning

Hints are not enough. You must make it clear to the employe what the prospects are: "If the situation doesn't improve, we may have to replace you."

Certainly, it's a shocker. Yet, the warning must be specific and beyond any possibility of misunderstanding.

This approach, tough though it seems, accomplishes two purposes—

- You make it possible for the employe to alter or improve the failings which are causing you concer.
- You eliminate once and for all getting yourself into a situation where he may justly say: "It was up to you to let me know how bad the situation was."

2. Prepare Yourself

If you have gone through the ordeal of firing someone, you probably realize this fact: you, yourself, are at least 50 percent of the problem.

Accordingly, you must adjust your mental machinery to be able to handle the firing interview properly.

It's largely a matter of throwing off compensatory attitudes, attitudes you assume to offset your own emotional involvement. If you have thought the decision through, are sure of the fairness of your stand, guilt feelings are unfounded.

But don't underestimate the depth of your feelings in such a situation. In few cases can you work closely with an individual without developing a sense of closeness and friendship. A

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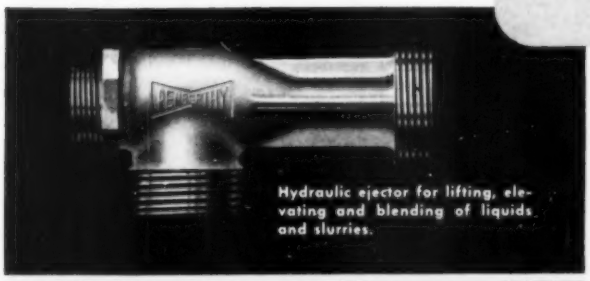
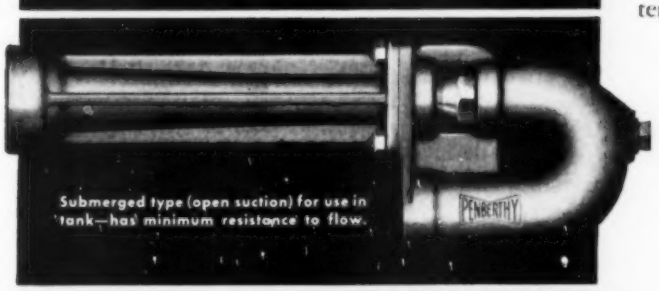
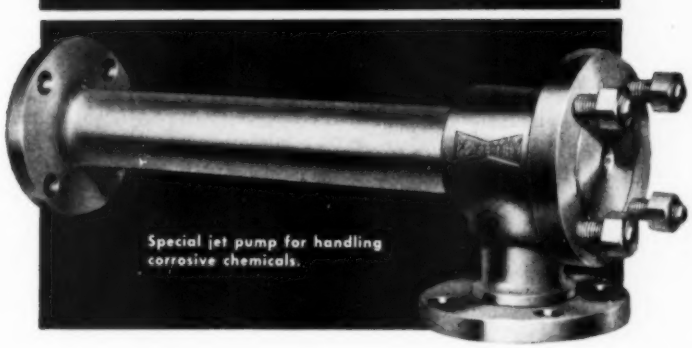


Hydraulic ejector for lifting, elevating and blending of liquids and slurries.

Steam or air operated ejector for a wide range of operating conditions.



Submerged type (open suction) for use in tank—has minimum resistance to flow.



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situation you might be able to handle objectively may become almost unbearable when an old acquaintance is involved.

Part of your preparation, therefore, is to spot in your approach signs of tentativeness or defensiveness. Just as frequent is the tendency to cover up by a display of gruffness or argumentativeness.

Of course, there is another possibility. Where the person you're firing is one with whom you don't get along, you may feel the urge to make the interview the final (and for you, victorious) action in your feud.

But such an approach, needless to say, is a direct threat to both personal and company employe relations. Reaction to an executive who makes dismissal an opportunity to indulge in his personal spite is bound to be bad.

Accordingly, search for and eliminate in advance any tendency you may have to be bitter, sarcastic or vengeful. *The strongest note of the interview should be one of finality.* And you make that point best by being calm and matter-of-fact.

3. Lock the Door

This is one interview you want to be private. As a matter of fact, the way you conduct the interview in itself will determine the results you get. A slipshod, curt chat squeezed in between phone calls or in the hearing of any passerby, naturally makes the employe feel resentful.

The business at hand is important to the employe. He feels he is entitled to your full attention for as long as *he* thinks it's necessary.

Select, then, a time and place when you can talk without interruption. Use these points to guide your selection:

- Hold the talk as soon after you make the decision as possible. This will cut down the general feeling of drift that may affect both the employe and the rest of your group. Your own actions are likely to supply the tipoff. Once you have decided to let an employe go, you almost unconsciously stop treating him as you did before. Your change of manner will register and cause unrest among your other subordinates. They may even conclude that *you're* slipping.
- If possible, hold the talk during a lull in activity. Lunch time is one possibility; the end of the day another. This arrangement eliminates the usual work interruptions—the phone calls or unscheduled emergencies you can't prevent.

4. Start with Your Decision

It's best to make it clear at the outset what your intentions are. You don't want to be abrupt. Greet the employe and get him comfortably seated. Then, "Bill, we have discussed your work before. It has not improved and I am convinced now that you're only wasting your time if you stay on."

5. Stick to the Facts

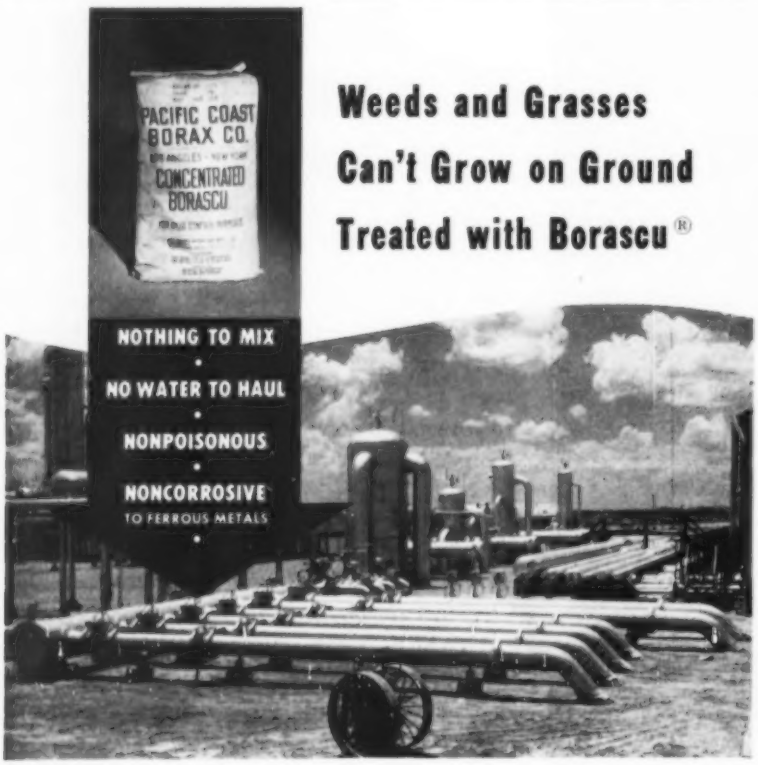
You'll avoid the emotional quicksand by keeping the conversation centered on the facts of the case.

For example, you may want to review briefly the faults and the steps you have taken to help him eliminate them. Don't be content to make general statements. Cite concrete, specific examples.

Note: If he can argue that you never called these matters to his attention before nor indicated their importance, you're in a weak position.

To eliminate pinning yourself into a corner, be sure in advance that you have lined up your examples carefully. This eliminates the need for you to grope for the facts.

The extent to which you'll review



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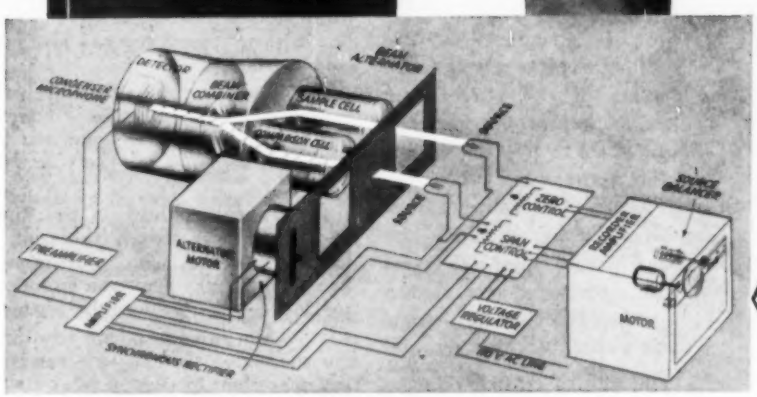

Schematic diagram showing components and operation of the M.S.A. Infra-Red Analyzer. Solid white line shows the path of the beam through the sample cell. Broken white line indicates the path of the beam through the comparison cell, interrupted by the beam alternator.

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As **Management** Sees It . . .

the record depends on the individual case. Where the individual is really at a loss for your action, you may want to spell out the warnings and the possible consequences you voiced.

In specific cases, executives who see the handwriting on the wall, may make a practice of keeping a written record of such pre-warning conversations.

6. Ease the Tension

It's a rare employe who is not under strain. It's up to you to help him release his tension. Your best move is to let him have his say. It's usually the rare case where the employe will admit that your decision is just. Here are some of the more likely possibilities:

• The tearful appeal. To this response, your strongest argument is that any other decision would only postpone the inevitable action.

• The angry denunciation. If this is the reaction you get, you may have to restate your case. But don't argue about it. If he can't be made to see the situation as you do, close this phase of the interview by indirectly indicating your decision is irrevocable: "You may not agree with me now, John, and I can understand your feelings. But some months from now, when you've settled in another job, you'll probably see it my way."

• Request for a "higher court." He may want to go to your boss to tell his side of the story. If that's the case, it's usually wise for you to agree. If you try to talk him out of it, it's only likely to heighten the desirability of the move in his eyes. The more readily you agree, the less likely he is to go through with it.

Of course, it goes without saying that your original decision must be sound enough to stand up under the examination of your superiors.

7. Help Him Along

Keep in mind the most painful aspect of his position. Essentially, you have just told him that he has failed. And it's failure at a vital point. Of course, you can point out that it's a failure largely dictated by *circumstances* rather than his personal limitations. Nobody is suited for every type of job. Nobody can fit into every type of situation which develops around a given job. You can diminish his feelings that the ground has been cut out from under him. Do it by pointing out other directions in which he can turn:

"While the place here isn't suited to your temperament, you'll find other jobs of this kind much easier by comparison."

"You can make this a real opportunity to find the type of work in which you're really interested, more in line with your ability."

You don't want to give him a rosy description of his chances, which he will instinctively know is over-colored. But in many cases, you can give specific assistance:

. . . Recommend the most likely direction in which he can go. "If you'd like to have my opinion, your best bet is a job where you can use your selling ability."

. . . A definite lead, if you know of any. "I hear that X Company is looking for men with your general background. Why don't you go up and see Mr. Jones who does the hiring?"

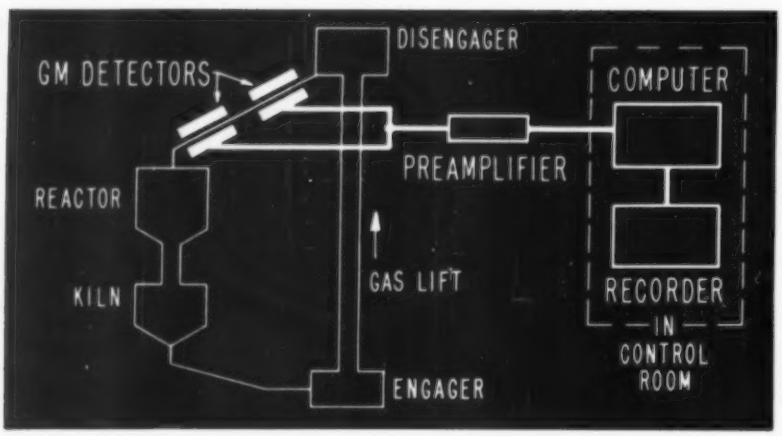
. . . And in cases where you think the suggestion will be well received, you may want to suggest weak points which, when strengthened, will better suit him for employment: "Brushing up on your mathematical ability would qualify you for a higher-paying job."

And if you can say it sincerely, add finally: "If I can be of help at any time, please let me know."

8. The Face-Saving Angle

For many an individual, the toughest aspect of the situation lies in con-

Problem: **Continuously measure catalyst flow rate in TCC or Houdriflow Catalytic Crackers**



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cern over the reaction of fellow employes. He may be less distressed over losing his job than with the reaction of his colleagues.

Sometimes, by just taking into account an individual's sensitivity regarding his standing in the group, you can ease the shock. Give him a chance to save his face, make him seem less of a failure.

That's why, in many cases, it's advisable to let a discharge pass as a voluntary resignation. Except where discipline is involved, this is frequently a method worth your consideration.

In any event, there is no reason for you to catalog an employe's deficiencies in public. In anything you may say to other employes, you need not condemn or criticize the ability or personality of the man who's leaving. The simple statement: "He didn't fit in" is usually adequate.

9. Smooth the Departure

It will make a big difference to the employe's peace of mind, as well as the reaction of colleagues, if the departure is handled according to a logical plan.

It's unwise to have the employe flounder across the finish line. Left to his own devices, he is apt to become a destructive force. On the other hand, there are usually many matters that require attention: your company's severance procedure may need explaining; you may have to arrange an appointment for the individual to see some one in the Personnel department. Departmental or company-wide severance procedures should be followed carefully.

In addition, there are two more points requiring your consideration:

In what shape is his work? In general, it's desirable to have a discharged subordinate leave as soon as possible. Depending on his attitude, however, you may want him to wind up his job. If it's practical from a personality viewpoint, you may even want him to take his successor in tow and acquaint him with the details, the loose ends and so on.

Finally, can you give him a chance to bow out gracefully? He would probably like to say goodbye without seeming to sneak off under a cloud.

Your attitude provides the principal key to the others. You can clearly show there is no reason for shame in his leave-taking, no hard feelings, no reason for doubts or resentments.

If the way is clear for a public announcement of the fact, it may be best to tell the group: "I am sorry to say

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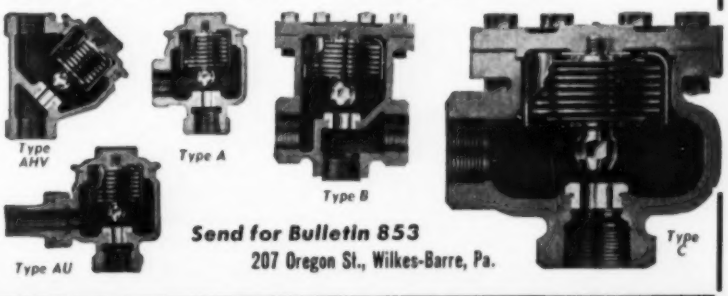

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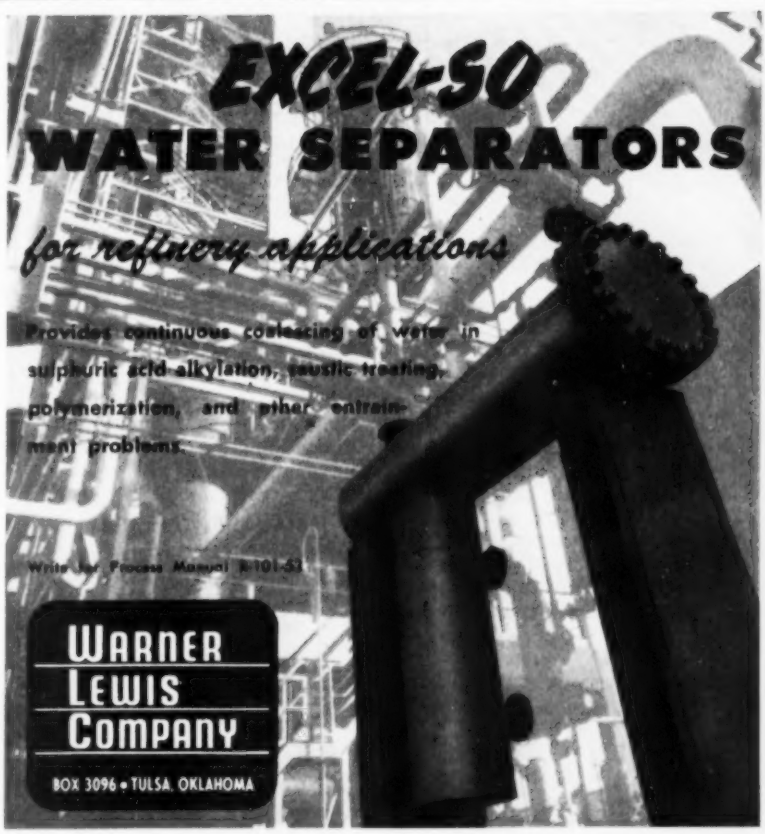
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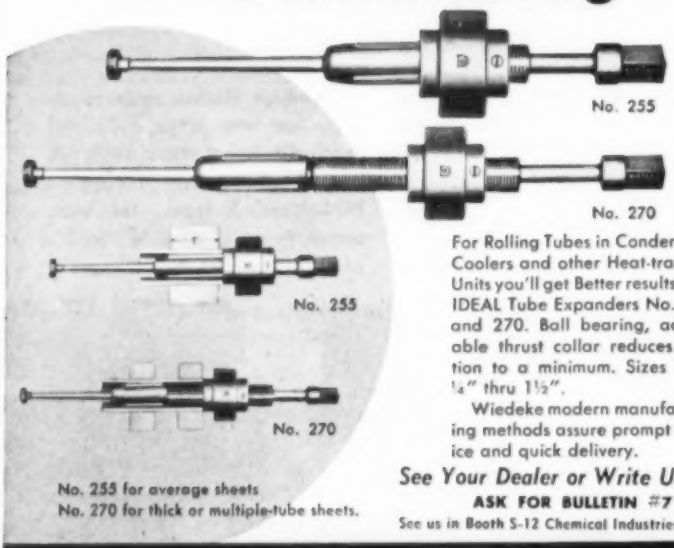

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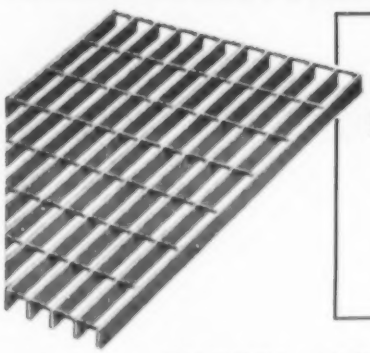

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As **Management** Sees It . . .

we are going to lose Henry. You girls better line up if you want to kiss him goodbye."

10. Analyze the Case

There's a lot to be learned from dismissals. In most instances where a subordinate is fired, there is a lot you can learn, personally. Questions like these help your analysis:

Why was the dismissal necessary?
What went wrong?
When should the trouble first have been detected?
Where exactly was the weakness?
Was it—
. . . hiring policy?
. . . your own inability to size up the man at the applicant stage?
. . . did he receive sufficient training?
. . . were orientation efforts made on his behalf intelligent and sufficiently strong?

And finally, the clincher—
How could it have been prevented?

The more intensive a study you make of your dismissals, the less of them you are likely to have. This brings automatic benefits—greater efficiency, better integration of your group as a whole, for the future.

Humble Continues Program With Twenty Fellowships

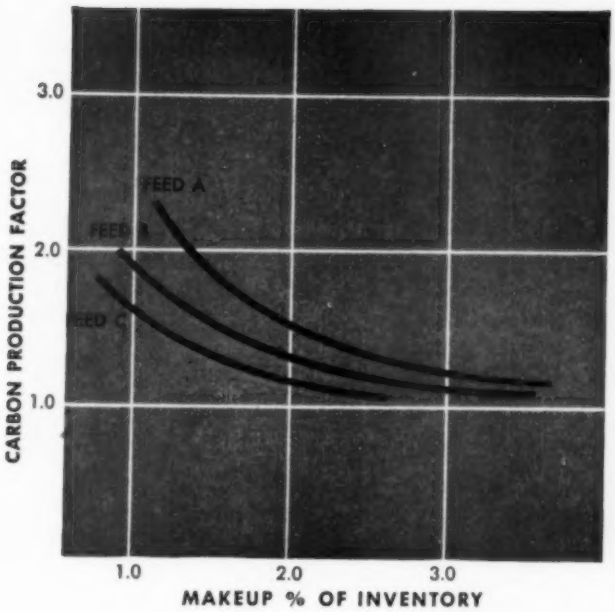
Twenty fellowships totaling $40,800 have been given by Humble Oil & Refining Company to be used at colleges and universities during the 1953-54 school year.

The fellowships will enable selected students to do graduate work in geology, chemistry, accounting, physics, law, and petroleum, chemical, civil, and mechanical engineering.

Schools which received the fellowship grants were Rice Institute, the University of Texas, Texas A. & M. College, the University of Oklahoma, Louisiana State University, Georgia Institute of Technology, the University of California at Los Angeles, Alabama Polytechnic Institute, and Massachusetts Institute of Technology.

Chabris Joins Grace Chemical As Industrial Relations Head

Peter D. Chabris has been named director of industrial relations for Grace Chemical Company's $19 million nitrogen plant now under construction near Memphis, Tenn. Chabris was formerly associated with American Telephone and Telegraph Company.



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$155/TON	6.35	1.4
$100/TON	10.0	1.2

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CPF	**PERCENT INCREASE IN THROUGHPUT	APPROXIMATE EXTRA INCOME
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1.2	36.5	$14,500

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As **Management** Sees It . . .

The Courts Say . . .

in recent insurance cases

Shelton

This column is to inform—not advise. It presents the current trend in legal thinking on insurance cases. The law varies from state to state and its application depends upon the facts of the particular case. Do not attempt to apply it without consulting your attorney.

JOSEPH M. SHELTON, Attorney at Law, Dallas

That to save former defenses employer must show exemption from compensation act

EMPLOYE SUED EMPLOYER at common law for personal injuries received while riding in a truck driven by a fellow employe on mission for employer. Neither side mentioned whether or not employer was eligible to come under or was under the compensation act. The employer claimed the defense of contributory negligence on part of injured employe. The trial court would not allow the defense on the theory that it was abolished when the employer is eligible but doesn't choose to come under the act. The employer said the employe had the burden of showing that the employer was deprived of the defense.

The Texas Supreme Court said the employer had the burden of pleading and proving facts which showed him exempt from the provisions of the compensation act in order for him to retain the defenses which the act abolished.

—Phipps v. Evans 259 S. W. 2d 723 (Tex. Sup. Ct., 1953)

That injuries of innocent bystander resulting from employes' fight were not compensable

L— FOUND A NICKEL on the floor of employer's premises. W— claimed the nickel. A quarrel ensued between them and L— shot and killed W—. During the shooting a stray bullet struck claimant who was in no way involved and was at all times at the proper place engaged in regular duties for employer. Compensation was denied.

The court said the quarrel between L— and W— was in no way connected with their employment. The injury must be a risk of the employment and have some direct relation to the details of the work itself. The mere fact that employment brought the offender and the victim together is not sufficient to supply the element of casual connection between the employment and the injury.

—Long v. Schultz Shoe Co. 257 S. W. 2d 211 (Mo. Ct. of App.—St. Louis, 1953)

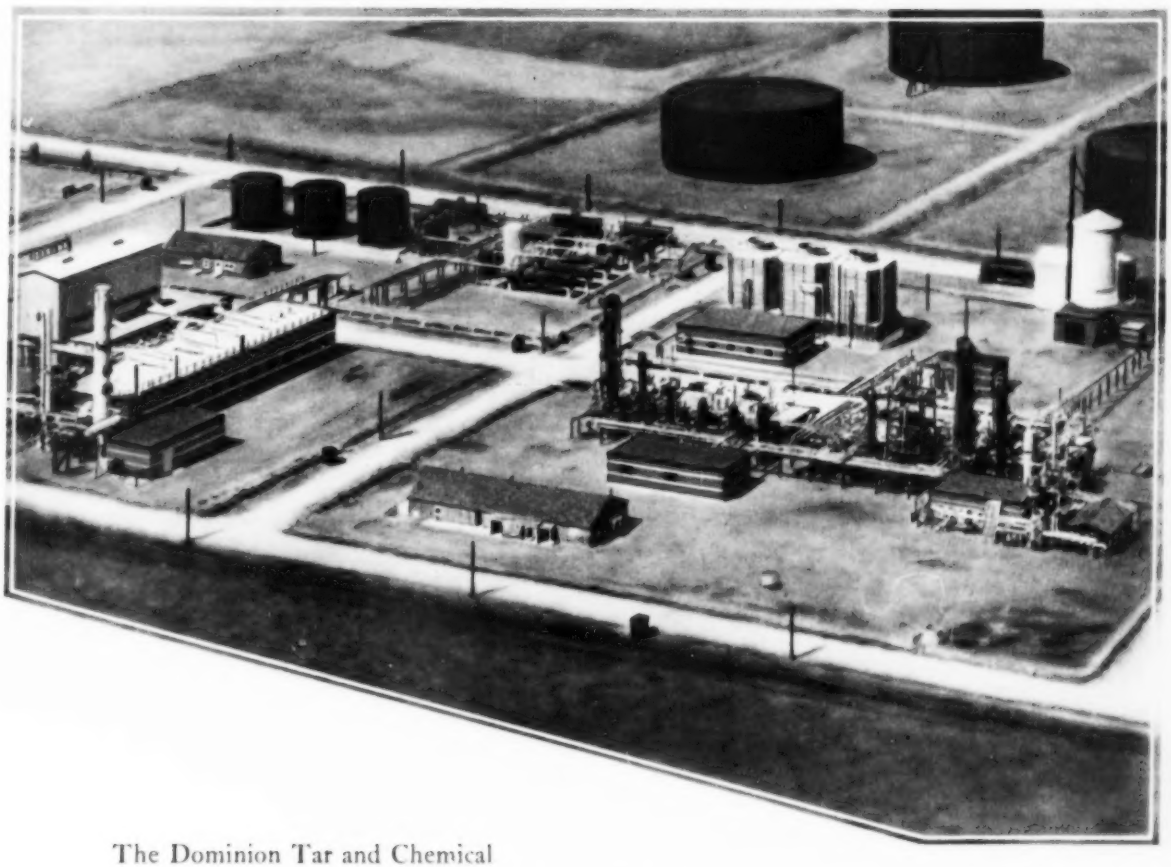
That death occurred from natural cause

EMPLOYE WAS HALF OF A TWO-MAN CREW stacking lumber. They had worked at about a normal pace during the day and as they walked to another load, employee who was carrying a 36-pound jack fell and died almost immediately. The diagnosis was coronary occlusion. One doctor testified he could have had the coronary at any time. The other said any unusual strain could aggravate the condition.

The Arkansas court said compensation is recoverable only when death or injury results from an accident. A worker whose death is perceptively hastened by reason of some unusual transaction—a transaction that might with reason be construed to be an accident—comes within the Act. However, compensation will not be paid where the work load was precisely what the employee had been engaged to carry and is not unreasonable.

—Faust Bond Saw Mill v. Richardson, 253 S. W. 2d 213 (Ark. Sup. Ct., 1953)

Chemicals FOR A FAST GROWING REGION



At this plant, located near the St. Lawrence River, Dominion Tar and Chemical Company extracts ethylene from gas piped from nearby refineries, converts it to form ethylene oxide and glycol, and returns the unused gas for further processing.

The Dominion Tar and Chemical Company's new plant at Montreal produces ethylene oxide, a component of detergents, solvents and plastics; and glycol, basic chemical in permanent type anti-freeze, explosives and synthetic fibers.

Design and construction of the plant, which has an estimated capacity of 25 million pounds of glycol per year, were by Stone & Webster Canada Limited, utilizing the facilities of Badger Process Division of Stone & Webster Engineering Corporation.

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What Suppliers Are Doing . . .

Harris Will Direct Valve Sales At American Locomotive Subsidiary

Beaumont Iron Works Company, a subsidiary of American Locomotive Company, has appointed Jack W. Harris sales engineer in charge of valve sales for process industries, and general industrial applications.

Harris

Harris has had experience in the design and sales of specialized valves with Cameron Iron Works, Inc., as a pressure still foreman at Gulf Oil Corporation, and as an Operating department head at J. S. Abercrombie Company and the Harrison Oil Company aviation gasoline plant.

New Division Established by Atlas Mineral Products Company

Atlas Mineral Products Company has formed a Thermoplastic Structures division, which will be responsible for the sale and field fabrication of the company's various polyvinyl chloride products, high impact styrene copolymer blends, and reinforced polyesters.

This division has established fabrication shops and sales outlets in 12 cities.

B&W Tubular Products Division Announces Four Appointments

Four appointments have been announced by the Tubular Products division of The Babcock & Wilcox Company. Those affected: A. B. Capron, formerly chief engineer, now assistant works manager in charge of the tube mills and engineering; Newell Hamilton, formerly superintendent of the steel mill, now manager of steel operations; William J. Thomas, formerly general sales manager, now general manager; and Paul J. Utnehmer, works manager, new member of the board of directors of the division.

Capron joined B&W in 1937 as a mechanical engineer. He was named chief engineer in January, 1952, and directed many plant improvements made during the last 18 months.

Hamilton went to B&W as a metallurgist in 1928. He advanced through many responsible positions and in June, 1942, when an electric furnace steel plant was built, was appointed superintendent.

Thomas has been with B&W since 1932. He was named assistant general sales manager in 1942 and general sales manager in 1948. He was appointed to the board of directors of the division in 1952.

Prior to going with B&W in 1945, Utnehmer was associated with a management engineering firm. He was named works manager at the Beaver Falls, Pa., plant of the Tubular Products division in 1948.

New Graver Tank Supply Division Formed Under Fogarty's Direction

Formation of a separate division for the sales and service of oilfield equipment has been announced by Graver Tank & Manufacturing Company. Known as Graver Supply Company, this division is under the direction of J. E. Fogarty, Mid-Continent area manager for Graver's plants in Sand Springs, Okla., and Odessa, Texas. Fogarty is general manager of the new division.

Fogarty

At the same time the company announced the appointment of Gerald G. Byer as area manager for the Oklahoma-Kansas territory. Byer has set up offices in Tulsa.

Colonel Rockwell Returns to Rockwell Manufacturing Company

Col. Willard F. Rockwell, who has resigned as assistant to Secretary of Defense Charles E. Wilson, has returned to his position as chairman of the board of directors of Rockwell Manufacturing Company. His resignation to Wilson was submitted in mid-September after he had made his final report following a three-week tour of North Atlantic Treaty Organization member countries.

The tour—his third for the Defense Department this year—was made for the purpose of inspecting principal sources of munitions supply for the NATO na-

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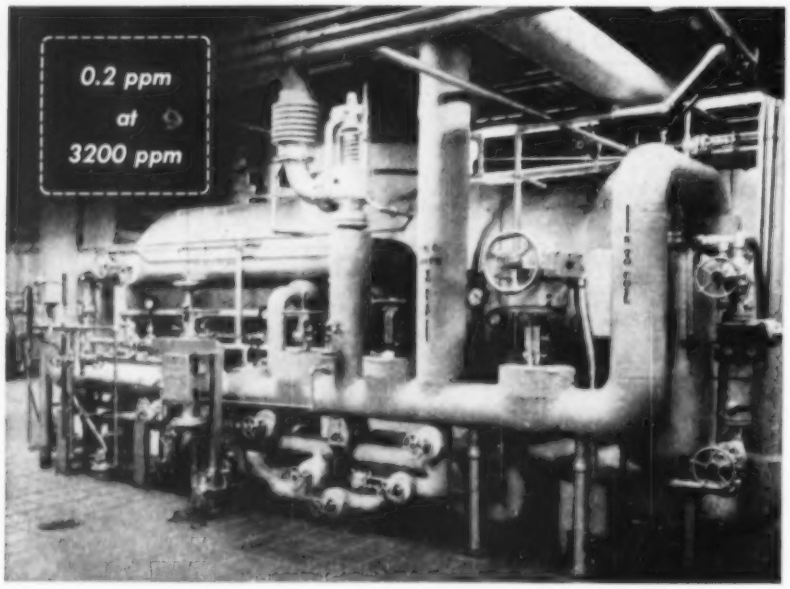
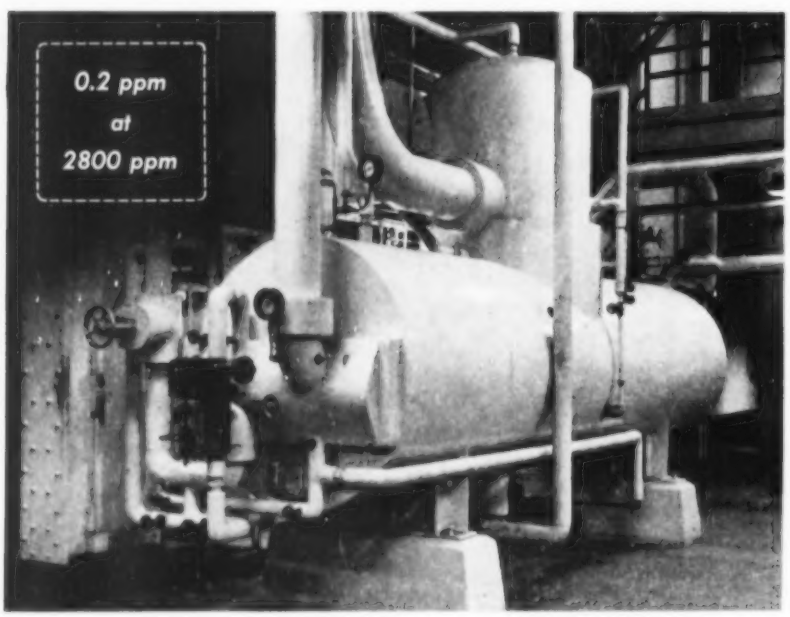


THREE Lummus Bubble Tray Evaporators at the Sunbury Steam Electric Station of Pennsylvania Power & Light Company were designed to produce 20,000 lb/hr net vapor at 1.0 ppm purity with a shell concentration of 3,000 ppm. A customer-conducted field test on #3 unit, at 24,000 lb/hr capacity, showed a vapor product solids content ranging from only 0.2 to 0.3 ppm despite a 3,200 ppm shell concentration. Other tests produced 30,000 lb/hr with a purity value averaging 0.6 ppm—well below design guarantees.

Note that in these tests favorable purity was maintained up to 50% *over* design capacity (a stability that wouldn't vary if load went down to only 25% *of* design).

. . . . . .

These tests prove evaporation sets the standards for vapor purity



TWO years after a Lummus Bubble Tray Evaporator was placed in operation at Rochester Gas and Electric's Russell Station, a field test was conducted to check performance. The test placed emphasis on precise determination of vapor purity on a gas-free basis. Results showed that purity did not exceed 0.2 ppm solids content at an average shell concentration of 2800 ppm for the test period.

Of great significance is the fact that this highly remarkable purity remained stable at loads varying from 10% overcapacity down to 25% of design throughput.

. . . . . .

These tests demonstrate why Lummus can guarantee evaporator performance of not more than 1.0 ppm with 3,000 ppm shell concentration. They also show what's available to you in *plus-performance* when you specify Lummus equipment for your heat exchanger requirements.

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125	275	450	1000	1550
138	288	500	1050	1600
150	300	550	1100	1650
163	313	600	1150	1700
175	325	650	1200	1750
188	338	700	1250	1800
200	350	750	1300	1850
213	363	800	1350	1900
225	375	850	1400	1950
238	388	900	1450	2000
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tions. Colonel Rockwell joined the Defense Department last April 1 at the request of President Eisenhower and Secretary Wilson.

Aluminum Skyscraper Dedicated—

Aluminum Company of America's new aluminum headquarters, the 410-foot Alcoa Building, has been dedicated in Pittsburgh. It is the lightest building of its size ever built.

One of the striking features of the 30-story structure is the stamped aluminum exterior paneling. Each of the 6 x 12-foot aluminum panels contains one window, roughly 4 feet square, which is reversed for cleaning inside the building. Weather is kept out by means of an inflatable rubber tube recessed in the window's aluminum frame. Begun in May, 1950, the building is completely air-conditioned. All electrical wiring and most of the plumbing is aluminum, as are lighting fixtures, elevator cabs, partition framing and many thousands of pounds of interior trim.

Aluminum Company of America is now occupying 25 floors of the structure, with 5 floors rented to tenants.

R-S Products Corporation Merged With S. Morgan Smith Company

S. Morgan Smith Company has announced the merger of its wholly owned subsidiary, R-S Products Corporation, Philadelphia. S. Morgan Smith will continue operations under its own name. All sales, engineering and administrative functions have been moved to York, Pa., with sales and engineering being combined with the present Valve division. The company will continue to manufacture the R-S line of valves at the Philadelphia plant.

Carl J. Wilcox will serve as sales manager for the newly consolidated Valve division. Harry E. Shive will be manager of sales service. David W. Hopkins, formerly responsible for the subsidiary Valve division, will serve as

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- CUPRO-NICKEL, 30%
- CUPRO-NICKEL, 30% (High Iron)
- ALUMINUM BRASS
- ALUMINUM BRONZE, 5%
- DUPLEX TUBE

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"You can't buy better Brass"

chief valve consultant. Russel C. Ayers, also of R-S Products Corporation, has been appointed assistant to the sales manager.

Wells Made General Sales Manager In Appointments at Flexonics

Flexonics Corporation, Maywood, Ill., has appointed Thomas K. Wells general sales manager, a newly created post.

Wells

Sabel

Griesbach

Wells has been with the company 12 years and most recently was sales manager for the Bellows and Aircraft divisions.

At the same time the company named Howard W. Griesbach assistant sales manager and Richard H. Sabel sales development manager, another new position. Griesbach recently returned to Flexonics after eight years with Brown Instrument division of Minneapolis-Honeywell Regulator Company. Earlier he was with Flexonics for five years. Sabel was formerly general manager of Midwest Roof Deck Company.

Perkin-Elmer Announces Expansion Of Norwalk Manufacturing Plant

The Perkin-Elmer Corporation has completed a 20 percent expansion in plant space to provide manufacturing and laboratory facilities for infrared process stream analyzers at Norwalk, Conn.

The new 12,000-square-foot unit has been built onto the existing 50,000-square-foot plant at Norwalk. The unit was built to meet the anticipated demand for the new Perkin-Elmer infrared process control analyzers. A group of development and application engineers will also work within the new unit

Conlon Appointed Vice President Of New York Belting and Packing

Joseph A. Conlon has been appointed vice president of New York Belting and Packing Company succeeding Ben F. Reuther, who has retired after more than 48 years in the rubber industry. Reuther, who began his career with Peerless Rubber Company, Passaic, N. J., in 1905, will continue in an advisory and consulting capacity. Conlon, who will function as the company's senior operating executive, was named vice president in charge of sales in October of last year.

Furfuryl Alcohol Production Starts at New Quaker Oats Plant

The Quaker Oats Company has begun production of furfuryl alcohol at its new Memphis, Tenn., plant, using a new catalytic hydrogenation process developed in its research laboratories. The new $600,000 plant uses a continuous vapor phase process and has facilities for recycling excess hydrogen as well as catalyst regeneration. Shipments of furfuryl alcohol from the plant are scheduled to begin shortly.

Kreider Joins Darling Valves As Manager of General Sales

The Darling Valve & Manufacturing Company has added Frank B. Kreider to its staff as general sales manager. For the past four and one-half years he has been Eastern regional manager, Insulation division, Pabco Products, Inc.

Holbert and Cross Elevated to New Positions at Johnston Pump

C. L. Holbert and Rex D. Cross have been appointed to new positions with

Holbert

Cross

Johnston Pump Company of Pasadena, Calif.

Holbert, formerly vice president-treas-

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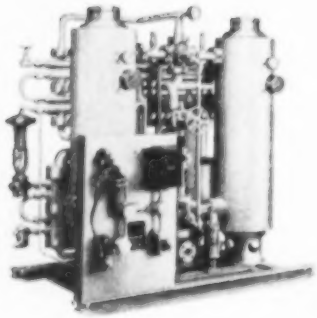

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urer, moves up to vice president-general manager.

Cross, who was district sales manager, southeastern states, takes over as national sales manager.

Both men have been associated with the pump manufacturing industry for many years at Johnston and other firms.

Three District Office Managers Get New Assignments at Elliott

Elliott Company has appointed three district office managers to commercial vice presidents.

Windau

Strickler

Pahren

H. S. Pahren, formerly New York district manager, joined Elliott in 1924. He was Tulsa manager for several years and was manager of the St. Louis office for five years.

W. E. Windau, since 1941 Chicago district manager as well as midwestern manager, became a field engineer in the company's Cleveland office in 1920.

J. H. Strickler, manager of the company's Pittsburgh office since 1931, was assigned to that office in 1923 as a field engineer.

Borchers and Sanford Receive Appointments to Bristol Posts

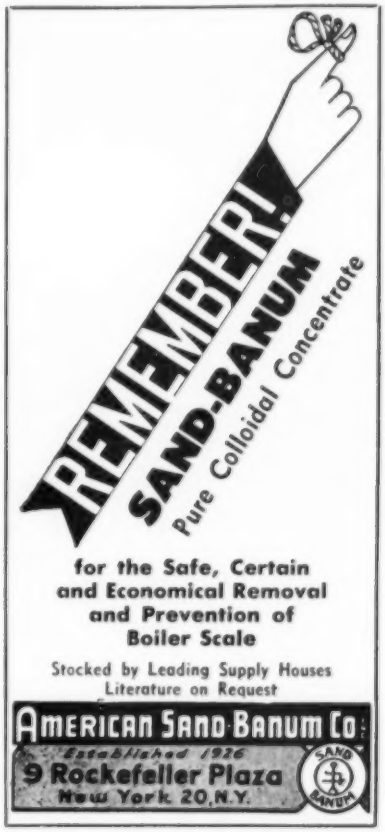
F. W. Borchers has been appointed general sales manager of The Bristol Company. Borchers, who joined the Bristol sales engineering organization in 1922, will maintain his headquarters at the company's main office at Waterbury, Conn. Prior to his recent appointment he was assistant sales manager of the company.

In another Bristol appointment, D. C. Sanford has become manager of the Application Engineering department. This appointee joined the company's sales organization in 1937. Since 1948 he has been an application engineer with headquarters at Waterbury. He will continue to make his headquarters there.

$400,000 Warehouse-Office Will Be Built by Alcoa at St. Louis

American Locomotive Company has scheduled the construction of a new warehouse and office building in St. Louis. The one-story structure will serve as Alco's diesel locomotive parts storage depot in the southwestern part of the country. It will also have space available for the district sales staff.

The building, which is expected to be completed next spring at an estimated cost of $400,000, will be located on a



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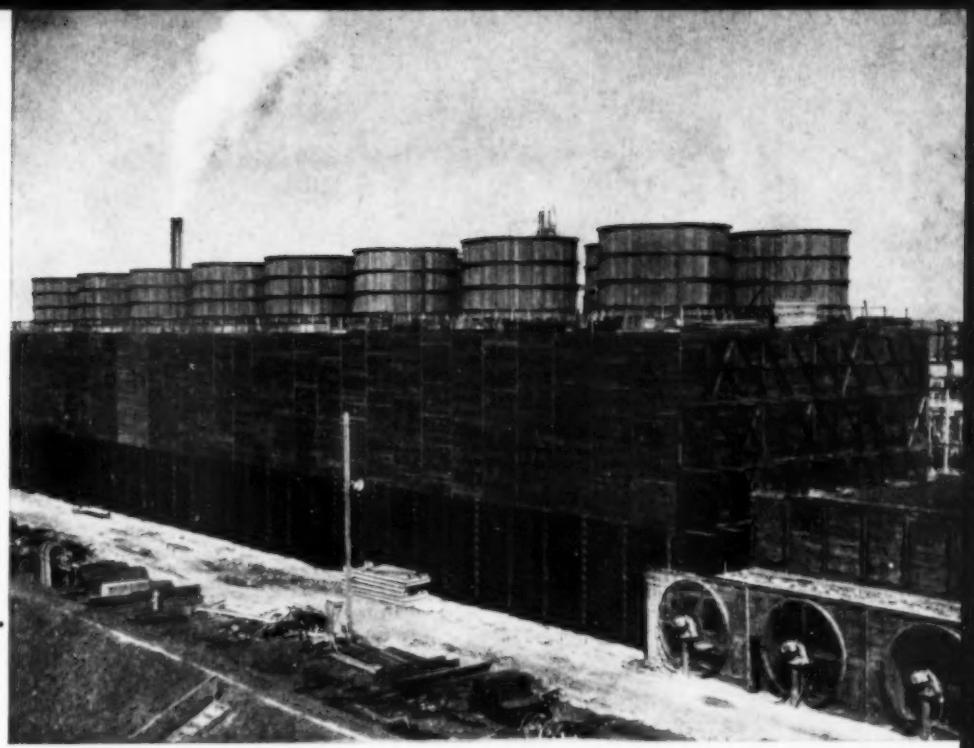

View, showing 16 cells of new Foster Wheeler cooling tower erected on foundation of old tower. Portion of old tower, shown at right, was replaced by 8 cells of new tower.

Tailored to fit customer plant conditions!

THE ERECTION of this new 24-cell cooling tower on the same foundation as the 56-cell tower which required replacement, without interruption in cooling capacity, is another example of the ability of Foster Wheeler to tailor the job to conditions in the customer's plant.

To assure a continuous supply of cooling water while the new tower was being built, 30 cells of the old tower were razed and the remaining 26 cells connected to two smaller existing towers by a temporary flume. The first 16 cells of the new tower were then erected and put into operation in time to meet the oncoming summer heat load. The remainder of the old tower was then removed and the balance of eight new cells erected.

It is through such unusual types of installations that Foster Wheeler has gained the reputation for engineering and construction excellence.

FEATURES OF THIS INSTALLATION:

Combination cast iron and red brass distribution system, with 720 special full coverage red brass up-spray nozzles, provides uniform water distribution over a wide variation in water flow rates. Induced-draft fans with 16-foot stacks discharge tower vapors at a high velocity 60 ft. above basin curb—reducing recirculation to a minimum.

The new tower requires 4320 sq. ft. less ground area than the old tower—enough to allow for the addition of four 30 ft. by 36 ft. cells for future requirements.

* * *

DESIGN CONDITIONS

Capacity	48,000 U.S. gpm
Inlet water temperature	120° F
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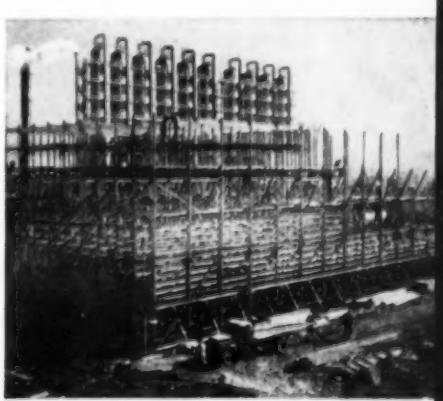
Wet bulb temperature	80° F



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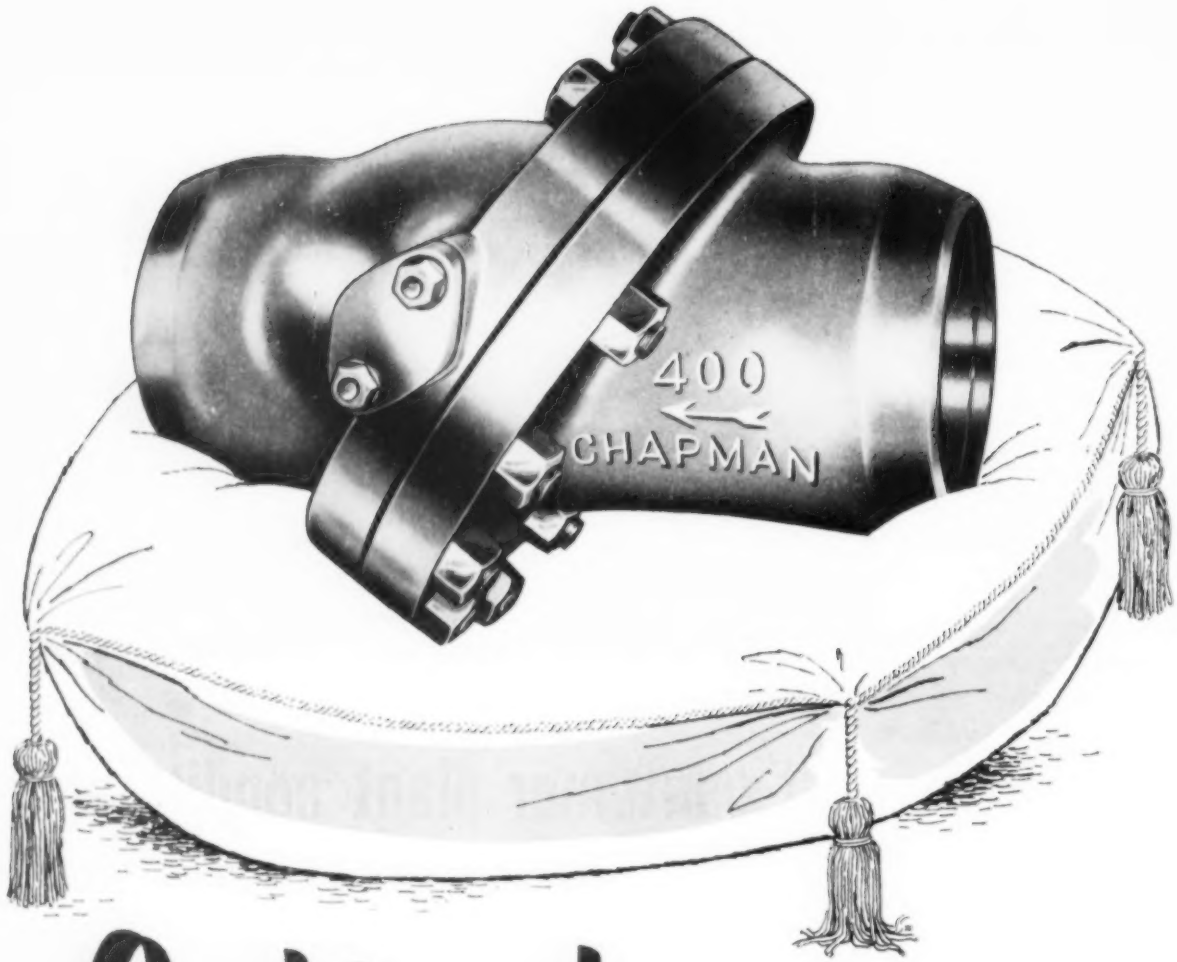

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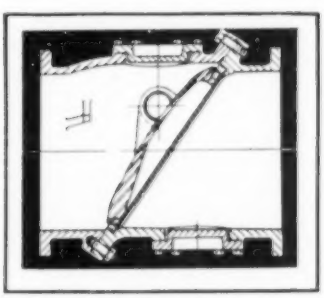

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This specially designed, "air-foil" disc balances perfectly in open position . . . then drops easily to closed position (cushioned by the flow). No jarring or slamming, in usual pipe-layouts. Write for bulletin.

CHAPMAN TILTING DISC **CHECK VALVES**

plot of more than two acres which was purchased from Koppers Company, Inc. Contracts for the pilings and general construction will be awarded shortly. Engineers and contractors for the project are Stone and Webster Engineering Corporation.

Cutler and Mercer Get New Posts In Goodyear Hose Sales Department

J. L. Cutler has been appointed technical consultant in the Hose Sales department and R. E. Mercer has been named

Cutler Mercer

to succeed him as assistant manager of that department at Goodyear Tire & Rubber Company.

Cutler has had wide experience in technical, development and sales work since joining Goodyear in 1928. He has worked in Hose Development and Hose Sales, and, in 1945, he advanced to senior staffman in the Hose Sales department.

Mercer started with Goodyear in 1947 as a field office trainee. In 1949 he was assigned to Duluth, Minn., as a field representative and was transferred to Des Moines, Iowa, in the same capacity in 1951.

Morken Appointed Vice President In Promotions at Kennedy Valve

In promotions announced by Kennedy Valve Manufacturing Company, Carl H. Morken, formerly works manager, has been named vice president in charge of manufacturing, and Thomas S. Turkington, controller, has been given the additional responsibility of secretary.

Prior to joining the Kennedy firm in 1952, Morken was plant manager for Donovan, Inc., of St. Paul, Minn. He previously had been chief metallurgist for The Ohio Brass Company, Mansfield, Ohio.

Turkington went to Kennedy Valve in 1945 as general auditor, advancing to controller in 1950. Previously he was a supervising senior accountant with Miller, Donaldson and Company of New York.

Shepherd Made Tubular Sales Head In U. S. Steel Division Changes

Paul H. Shepherd has replaced John M. Post, retired, as manager of Tubular Sales for United States Steel Corporation's Oil Well Supply Division. Shepherd, who joined "Oilwell" in 1916 has been assistant manager, Tubular Sales, since June, 1950. He will continue to headquarter at Dallas.

Another appointment by the Oil Well Supply Division moves W. G. Yochum, formerly office manager of the Tubular department, to assistant to manager of the Tubular department. Yochum, who has been with U. S. Steel since 1922,

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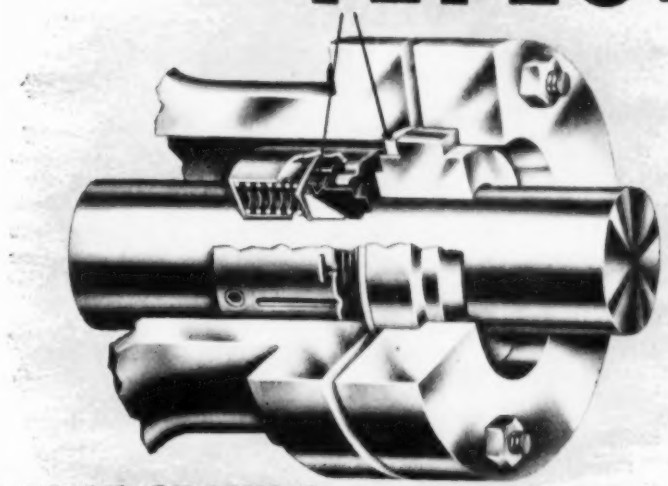

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This revolutionary seal was developed by Crane Packing Company after two years research and field testing—expressly for use with hard-to-handle chemicals. Its flexible wedge ring and sealing ring are molded from the remarkable new plastic, Teflon, which is not affected under any known corrosive or solvent service.

John Crane engineers thus put the unique properties of Teflon—high heat resistance, extremely low friction and chemical inertness—to practical use in the Type 9 Seal. Result: a new, efficient way to handle corrosive liquids and gases that never before could be effectively controlled by conventional, flexible-type mechanical seals. It can be employed at temperatures up to 500°F.

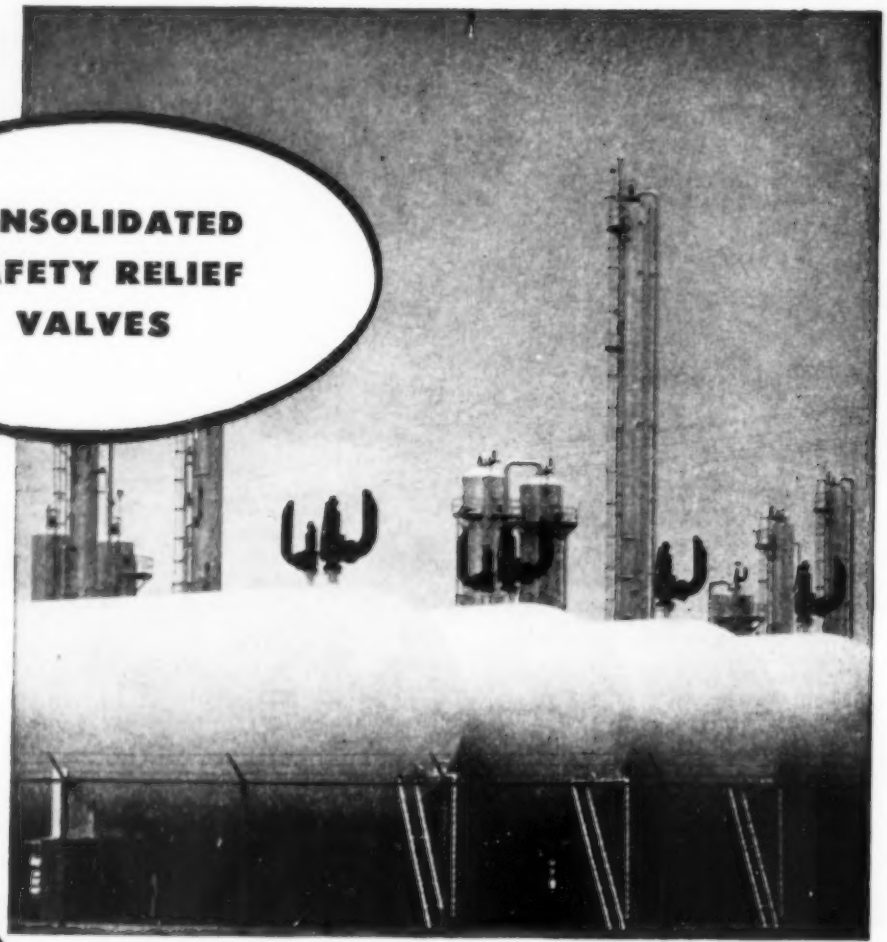
The Type 9 Seal gives consistently dependable service on all rotating shaft applications, such as centrifugal pumps, turbines, speed reducers, positive displacement pumps and agitators

Write today for new booklet describing the "John Crane" Type 9 Shaft Seal—
CRANE PACKING COMPANY, 1820 Cuyler Ave., Chicago 13, Illinois

*DuPont's trademark for tetrafluoroethylene resin

JOHN CRANE CRANE PACKING COMPANY

CONSOLIDATED SAFETY RELIEF VALVES



OUTSTANDING FOR SAFE SERVICE

ABSOLUTE PROTECTION against overpressures is the one and only function of Consolidated Safety Relief Valves—and they give it. Proof of their unbeatable performance is evident in the many unfired pressure vessels—gas, vapor and liquid storage tanks, pipelines, pumps—safeguarded by these valves throughout the processing industries.

You want complete protection for your personnel, property and equipment. Consolidated Safety Relief Valves provide it. They don't leak under discharge piping stresses—outsdie bevel seat and floating guide construction permit the disc to seat on a radial seating surface. *Dependable tightness* is assured in all positions within the deflection range. You can be sure of continuously reliable performance at the rated capacity, even in the most severe service.

Invest in Consolidated Safety Relief Valves and you also get the fundamental advantage of *simple design*—high quality valves that serve better and longer because they have 25% fewer parts than ordinary safety valves.

Your local Consolidated Safety Relief Valve Industrial Distributor will explain how much this can mean to you in economical maintenance and simplified standardization. Phone or write him today. He is your best source for quick information and service.

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A product of **MANNING, MAXWELL & MOORE, INC.** TULSA, OKLAHOMA

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VL-5
VALVE LUBRICANT

WITH MOLY-DISULPHIDE

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DOMESTIC EXPORT
LABORATORY APPARATUS & CHEMICALS
HOUSTON • NEW ORLEANS
TULSA • BIRMINGHAM • NYC

"Oilwell" since 1935, will make his headquarters in Pittsburgh.

Rockwell Elevates Fomilyant to Macnick Division General Manager

A. A. Fomilyant, Los Angeles district manager of Rockwell Manufacturing Company's Meter and Valve division, has been named general manager of the company's Macnick division at Tulsa, Okla. He succeeds W. M. Connor, who will supervise sales and production liaison between the division's national headquarters at Pittsburgh and divisional plants and field offices.

Fomilyant

E. M. Cloran, Western regional supervisor of gas products sales, succeeds Fomilyant as division district manager.

Fomilyant, who began his business career as assistant editor of Western Business Papers, Inc., in 1934, joined Rockwell in 1938 as a sales engineer. He was named Los Angeles district manager in January, 1952.

Allegheny Ludlum Expands Program For Zirconium Strip Production

Over two years of research and production experience has led Allegheny Ludlum Steel Corporation to expand its program for the production of zirconium strip and other shapes for atomic energy applications. Allegheny Ludlum's work in this field has been carried on as a project in cooperation with Atomic Energy Commission's Bettis plant, at Pittsburgh, operated by Westinghouse Electric Corporation.

The usefulness of normal zirconium for atomic reactors is limited by the presence of small amounts of the element hafnium, present as a contaminant in the metal. The Oak Ridge National Laboratories of the Atomic Energy Commission has developed a method to remove hafnium and it is now possible to obtain sponge which is free from the element. The U. S. Bureau of Mines has been producing this sponge, melting it into ingot form. Allegheny Ludlum has become the first private organization to go into the melting of this sponge material.

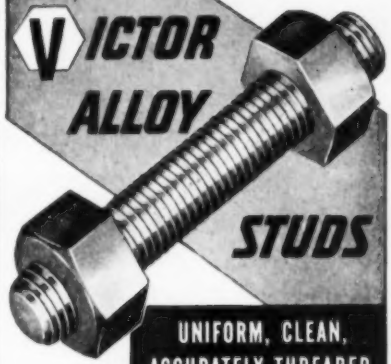
Retirement of Curtis Brings Changes in Timken Sales Staff

With the retirement of George W. Curtis as Milwaukee division sales manager, The Timken Roller Bearing Company has made several changes in its sales organization.

The Milwaukee Industrial Sales division responsibility has been divided among the district offices in Milwaukee, Minneapolis and Moline. Robert Morgan, district manager at Moline, continues in that post while Floyd Hartshorn, who has been connected with the Milwaukee sales office since 1939, except for time spent in the service, becomes the district manager of the Milwaukee office. Donald Van Orman, who has been in the Minneapolis office since December, 1950, is now district manager at Minneapolis.

Curtis had been with Timken 33 years at the time of his retirement October 1. Before becoming division sales manager

VICTOR ALLOY STUDS



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VICTOR alloy Studs and Bolts have met the exacting standards of the oil industry for more than 30 years. Victor is accustomed to meeting your requirements of quality, price and delivery. Try VICTOR next time you need any fastening.

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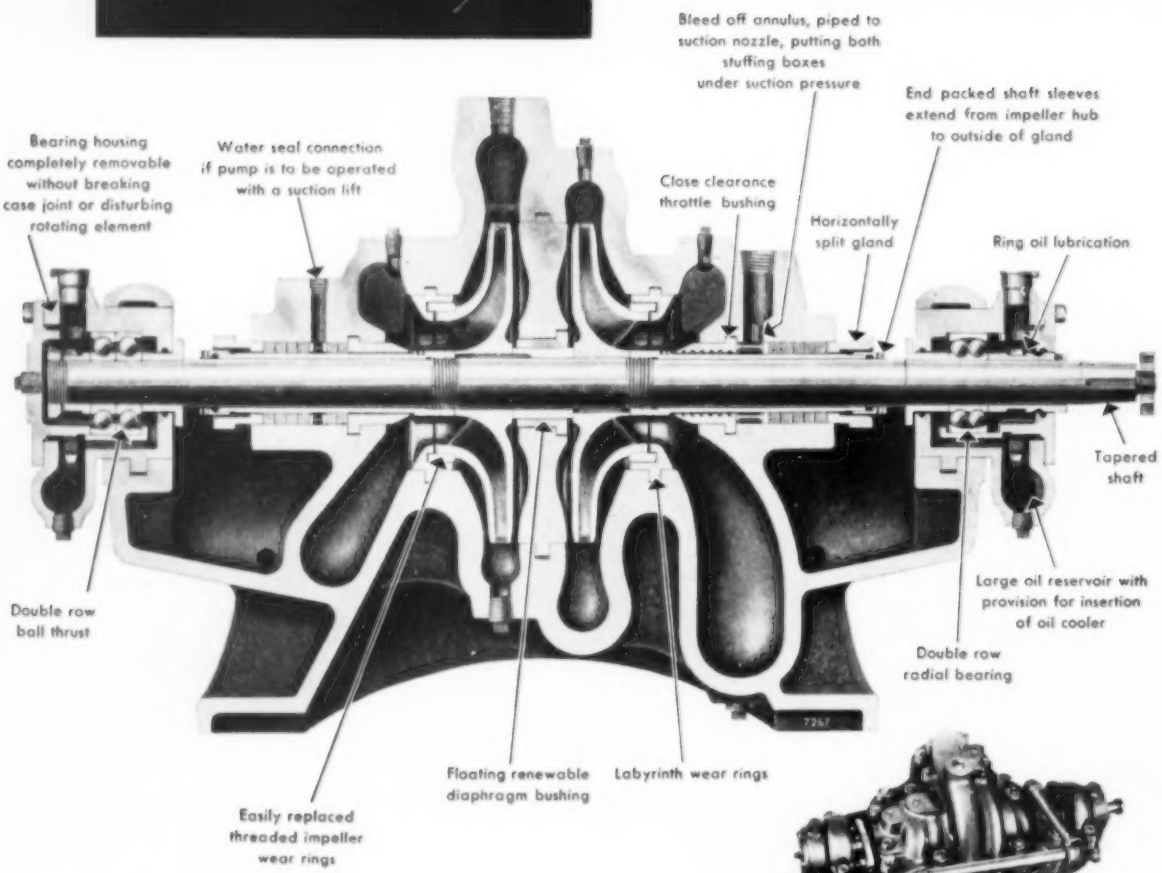
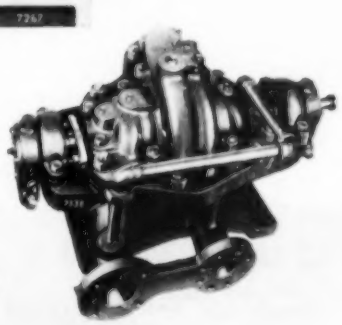
100 Quimby St., Westfield, N. J.

DE LAVAL
TWO-STAGE
HORIZONTAL PUMPS


Bleed off annulus, piped to suction nozzle, putting both stuffing boxes under suction pressure
End packed shaft sleeves extend from impeller hub to outside of gland
Bearing housing completely removable without breaking case joint or disturbing rotating element
Water seal connection if pump is to be operated with a suction lift
Close clearance throttle bushing
Horizontally split gland
Ring oil lubrication
Tapered shaft
Double row ball thrust
Large oil reservoir with provision for insertion of oil cooler
Double row radial bearing
Floating renewable diaphragm bushing
Labyrinth wear rings
Easily replaced threaded impeller wear rings
7267



These 14 Design Features Insure Long-range, Low-cost Service

Look at the important design features highlighted in this cross-section. You will clearly see why De Laval 2IS-2KS Two-Stage Horizontal Pumps are designed to give you long, dependable, highly efficient service. ● These pumps are precision-made to quality manufacturing standards. They are available in capacities from 75 to 3,000 gpm, sizes from 2″ to 8″ discharge and heads to 750 feet. Write for Bulletin 1501 giving complete data.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY

811 Nottingham Way, Trenton 2, New Jersey

DL-229

in 1943, he was the district manager at Milwaukee for 14 years.

Patterson Foundry & Machine Opens New Tulsa District Office

A new district sales office has been opened in Tulsa by The Patterson Foundry & Machine Company. W. V. C. Jackson, who has represented chemical processing manufacturers in the Tulsa area for 24 years, has been named manager of the new district office.

This new Patterson sales office was established to provide faster, specialized service to the petroleum, chemical and allied industries, the company reported.

Jackson

Kansas City Warehouse-Office Opened by Ansul Chemical

Ansul Chemical Company has opened a new office and warehouse at Kansas City, Mo. The new building is headquarters for the sale of the company's dry chemical fire equipment, refrigeration products and industrial chemicals in the Southwest. Territory to be serviced includes Missouri, Kansas, Nebraska, southern Illinois, Arkansas, Oklahoma and the Texas Panhandle. C. H. Armstrong, regional fire equipment manager, and Roy McCrady, refrigeration district manager, will supervise the operations. Robert Brewer and Thomas Gorman will assist Armstrong.

Company Personnel Changes . . .

United States Steel Supply Division of United States Steel Corporation has been appointed distributor for **A. O. Smith** welding products in the West Coast area . . . **Virgil C. Reed,** experienced in the engineering and sales aspects of the welding industry, has been appointed field representative for the southeastern and southwestern states by **Alloy Rods Company,** New York . . . A new Houston branch plant has been established by **Tube Turns, Inc.,** under the direction of **W. B. Whenthoff,** district manager. District offices of the company, formerly in the Commerce Building, Houston, have been moved to the plant . . . **Dowell, Inc.,** has moved into new headquarters at Depew, N. Y. The new construction includes sales and services offices, two warehouses, dock, solvent storage tank and garage for storage and maintenance of trucks.

John C. Lane, formerly head of technical information services at the Georgia Tech Engineering Experiment Station, has joined the staff of the information service group of **Ethyl Corporation's** Research and Engineering department at Detroit. He will assist in the preparation of technical publications dealing with Ethyl's research in the automotive-petroleum field . . . **W. D. Sullivan,** assistant works manager of the Tubular Products division of **The Babcock & Wilcox Company,** has been transferred to the company's Boiler division, where he will be regional manager, assisting in the coordination of the division's manufacturing activities.

John S. Carr, sales engineer, has been appointed manager of pump sales for American Manganese Steel division of **American Brake Shoe Company.** He has been with the company since 1949 . . . **Howard H. Foster,** assistant treasurer of **Air Reduction Company,** has been elected treasurer of the firm, succeeding William Winters, Jr., retired . . . **Arthur L. Foltz, Jr.,** has been appointed manager of **De Laval Steam Turbine Company's** Detroit district office, from where he will head sales and application in that territory of centrifugal pumps, steam turbines, centrifugal blowers and compressors . . . **Henry C. Earle, Jr.,** who has 20 years experience in the instrument and control valve business, has been appointed sales manager of **The Annin Company,** with headquarters at Los Angeles . . . **J. Curran Freeman** has been appointed controller of **Dresser Industries, Inc.** He was formerly with Ford Motor Company and Allis-Chalmers Manufacturing Company.

New American Corporation Set Up By Richard Klinger of England

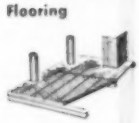
Richard Klinger, Ltd., British manufacturer of compressed asbestos packings, has announced the formation of The Klinger Corporation of America, with main offices at 95 River Street, Hoboken, N. J. The new corporation will have a New York office at 17 Battery Place.

Principals in the new firm are L. O.

USE THIS NEW SAFETY MATERIAL ALL OVER YOUR PLANT

Work platforms

Flooring



Gutter covers

Partitions

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NON-SKID—RUGGED—LOW COST

Safety Grip-Strut is a new basic material. All one piece, steel or aluminum, in various sizes and gauges. Sold like lumber, used like lumber and stocked in your storeroom like lumber. Ideal for on-the-job fabricating. Not welded, riveted or expanded. It presents an open space, in a diamond shaped pattern, in excess of 75% of the area for ready access of light and air and gives a positive NON-SKID footing in all directions. Ideal for stair treads, fire escapes, cable trays, work platforms, catwalks, flooring and for original equipment safety treads. Your own mechanics can install it—it's inexpensive, yet permanent and safe.

Write today for new catalog showing loadings and methods of easy application in your plant.

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It takes more than machines to produce steel for the Petro-Chemical Industry. It takes years of experience. The John Dollinger, Jr., Corporatioon has that experience. That's why more and more firms are calling upon Dollinger to help them meet their fabricated steel requirements.

FOR OVER 50 YEARS, LEADERS IN THE PETRO-CHEMICAL INDUSTRY HAVE LOOKED TO JOHN DOLLINGER, JR., INC. FOR QUALITY STEEL FABRICATION AND DEPENDABLE DELIVERY.

For inquiries regarding fabricated structural steel and plate steel, write to John Dollinger, Jr., Inc., Beaumont, Texas.

Arringdale, president, and Vincent Maxwell and Raymond Oksala, senior engineers.

Slagle and Sheffer Reassigned In Changes Announced by ALCOA

Harry C. Slagle, manager of Aluminum Company of America's Chicago Works, has been transferred to Pittsburgh as manager of ALCOA's shop training program. He will be succeeded by R. E. Sheffer, staff assistant to the general manager of the company's Fabricating division.

Slagle joined ALCOA in 1925 at Buffalo, N. Y., and held positions at Pittsburgh, Jones Mills, Ark., and New Castle, Pa., before becoming works manager at Chicago in 1946.

Sheffer joined ALCOA in 1925 at New Kensington, Pa., advancing to chief metallurgist at the Alcoa, Tenn., Works two years later. He was made staff assistant in the company's Fabricating division in Pittsburgh last year.

Tube Turns Enlarges Staff With Addition of Grant and Chronister

Bert Grant and Clyde Chronister have been added to the staff of Tube Turns, Inc., as sales-engineering representatives. Grant has been assigned to the Pittsburgh office, Chronister to the Tulsa office. Before joining Tube Turns in July, 1953, Grant was associated with Capital Airlines, Associated Investment Corporation, and Williams & Company. Chronister has been with the company since June, 1953, was formerly with Orbit Valve Company.

A. O. Smith Emphasizes Cleanliness—

The 41,000-square-foot floor surface of A. O. Smith Corporation's new Eastern Welding Electrode plant near Lancaster, Pa., is fully vacuum-cleaned every 24 hours. This is but one of the many moves by the company aimed at excluding dust and dirt or other extraneous materials that cause imperfections in electrode manufacture. Cleanliness features of the new building include: no windows or skylights (as may be seen in the exterior front view above) for better control of the ingress of air; a system of air pressure balancing under which slightly more outside air is automatically admitted than is exhausted from the building; and propane gas which is used for both the baking oven and for heating the building.

Gustin-Bacon and 3M Team on Glass Fiber Plastic Pipe Work

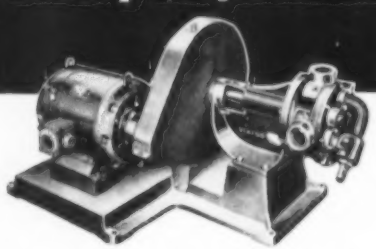
Minnesota Mining & Manufacturing Company and Gustin-Bacon Manufacturing Company of Kansas City, Mo., have announced an agreement whereby 3M acquires certain Gustin-Bacon patents and inventions relating to the manufacture of glass fiber reinforced plastic pipe.

The agreement also provides that the two companies cooperate in research and development work concerned with perfecting and improving the glass-plastic pipe together with a line of fittings and couplings.

Security Analysts Visit Sites Of Allegheny Ludlum Expansion

Principal points of interest in the $80 million expansion and improvement program executed by Allegheny Ludlum Steel Corporation since 1946 were recently inspected by 43 security analysts in a two-day tour. The trip covered five of the company's plants, including two in the Pittsburgh district. Included in the tour were visits to the Watervliet, N. Y., plant's new hot extrusion operation, the continuous casting pilot plant, the new electric steel melting shop, the 56-inch semi-continuous hot sheet-strip

There's a Viking Pump for every requirement



Viking Pumps are old reliable friends in the Oil Industry . . . and Southern Engine & Pump Company engineers are regularly utilizing their versatility and dependability in units for every service. Whatever your special requirement—they'll be glad to help you.

Pictured above: Gear drive unit includes gearing totally enclosed in sheet metal guard. Size and type of gearing as well as outboard bearing support depends on the size and speed of power unit needed.

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This portable, semi-automatic guided torch machine produces saddle and insert type tee intersections, straight or beveled cut-offs, miters and lateral intersections for most pipe sizes from 2" to 24". No layout or templates required and all cuts are extremely accurate and require no cleaning or hand-fitting. No limit to length of pipe that can be handled. Proved in the field and backed by 20 years of experience and engineering development.

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Is your coke "different"? LAGONDA can handle it!

• Some coke conditions are almost unique in their toughness. But they can be tamed and made to "say uncle" when tackled by the Lagonda brand of tube cleaning "know-how" backed up by the proper Lagonda cutter head with the hard-driving Lagonda 1100 Series motor behind it.

Your local Lagonda tube cleaning specialist regards a "different" coke condition as an inspiring challenge. Contact him—through us, if necessary—and let him do his stuff. It may save you plenty.

LAGONDA BULLETIN Y-34 gives a pretty complete story of the "how" and "why" of tube cleaning. Ask your local Elliott man, or write us direct.

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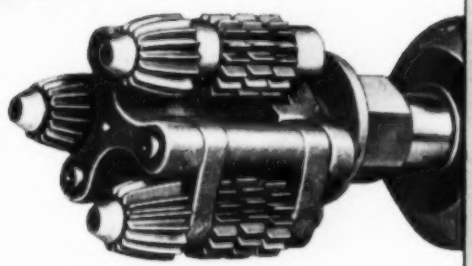
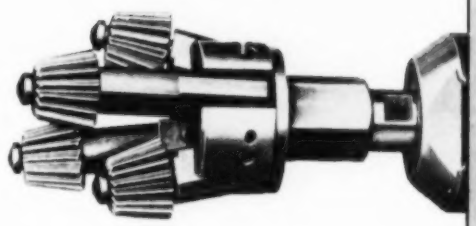
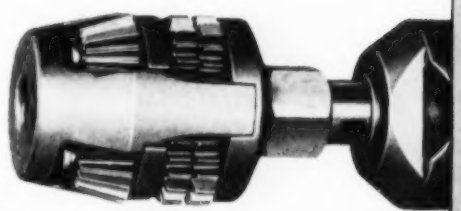
LAGONDA DIVISION, SPRINGFIELD, OHIO



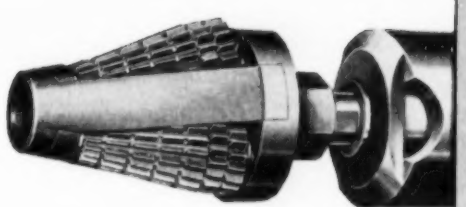
THE LONG-SURFACE SWING-FRAME HEAD with plenty of expansion for tubes of wide tolerance.



THE TYPE H-2 HEAD, particularly good on tough, uneven coke deposits.

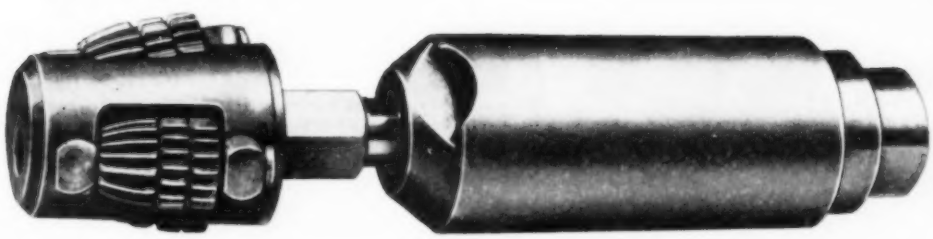


THE TYPE UD HEAD, widely used for its adaptability to average coke conditions.



THE TYPE UHC HEAD, designed especially and solely for extremely heavy coke.

THE 3600 SERIES DUPLEX CUTTER HEAD
a double or wide expansion type.



THE FAMOUS 1100 SERIES MOTOR, whose exceptional power requires the especially enduring design and construction common to all heads illustrated.

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Y3-11

mill, the Brackenridge, Pa., cold rolling department, and the West Leechburg, Pa., silectron annealing building.

Sound Control Products Division Organized by Owens-Corning

Owens-Corning Fiberglas Corporation has organized a new Sound Control Products Sales division, with Ben F. Leaman, Jr., as sales manager. The new division will enable Owens-Corning to serve better the needs of its organization of acoustical contractors.

Leaman

Leaman joined Owens-Corning as an acoustical specialist in February, 1950, and was named manager of acoustical sales in May, 1951.

Crunkleton Becomes Distributor For Clark Equipment in Charleston

Clark Equipment Company has appointed Crunkleton Company, Charleston, W. Va., as a distributor of Clark's full line of materials handling equipment, including fork-lift trucks, towing tractors, powered hand trucks, and Ross Carriers. The new dealership is under the management of Leslie D. Crunkleton, Jr. For the past seven years Crunkleton has been general manager of the Fidelity Storage Company, Charleston, West Virginia.

Marlow Pumps Will Merge With Bell & Gossett Next Month

Marlow Pumps, Ridgewood, N. J., will merge December 1 with Bell & Gossett Company, Morton Grove, Ill.

Under the new set-up, Marlow Pumps will be known as the Marlow division of Bell & Gossett and will be headed by A. S. Marlow, Jr., as general manager. He will also be a vice president and a member of the board of directors of Bell & Gossett.

Calumet & Hecla Division Moves Julin to Midwestern Sales Office

Ralph Julin, who formerly represented the Wolverine Tube Division of Calumet & Hecla, Inc., from its Des Moines, Iowa,

Goodyear

Julin

office, has been moved to its Midwestern district sales office in Chicago. His former duties will be assumed by Thomas E. Goodyear, formerly an office sales representative in the company's general sales office in Detroit.

Burgess-Manning Assigns Oliver To Chicago Sales Territory

R. T. Oliver, Jr., of Dallas, has been assigned to the Chicago sales territory by Burgess-Manning Company's Dallas division. The Dallas division services the petrochemical industries.

Oliver

Oliver joined the Burgess-Manning sales division at Dallas in 1951. A veteran of the U. S. Navy Air Forces in the last war, he was graduated from the University of Illinois in 1949. In his new position, he will serve petrochemical industries in the Chicago sales area.

Moorhouse Elected to Succeed Krumhansl as McKee Treasurer

Arthur G. McKee & Company has announced the scheduled retirement next January 2 of J. Krumhansl as treasurer of the company. He will continue as a director.

H. R. Moorhouse, secretary and a director of the company for the past seven years, has been elected to succeed Krumhansl as treasurer. Moorhouse will be both secretary and treasurer January 2, 1954. His assistants will be Carl H. Ganzenmueller, presently assistant treasurer, and William R. Nichols, assistant to Moorhouse. Effective January 2, 1954, Ganzenmueller will be assistant secre-

How you can get longer pump-valve life

SIMS PUMP VALVES HAVE FOUR FEATURES THAT GUARANTEE LONGER LIFE

1 Double shock absorber stem heads—eliminate stem breakage.

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Professor, Karlsruhe Polytechnic Institute

Translated by M. WULFINGHOFF

Engineer, Sanderson & Porter

The first Englist translation of this authoritative reference work which is regarded as a classic in its field. Every phase of distillation and rectification engineering is thoroughly covered and the many diagrams and charts will be helpful in practical work.

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Separation of Mixtures of More Than Two Components.
Determination of the Dimensions of Rectifying Columns with Exchanger Plates.
Rectification in Packed Columns.
Details: Heat Exchangers; Control Equipment.
Molecular Distillation.
Appendix: Equilibrium Conditions of Binary Mixtures; Heats of Evaporation of Various Substances at 760 mm Hg; Specific Heats and Specific Weights of Liquids; Molecular Weights.
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Arlie W. Tempel
Phone: 8-1314

Beaumont, Texas
238 Bowie Bldg.
Lee T. Dodson
Phone: 4-7536, 4-7537

San Antonio, Texas
2012 Alamo Natl. Bldg.
Charles I. MacKenzie
Phone: GArfield 3161

Memphis, Tennessee
713 Columbian Mutual Tower Bldg.
Robert W. Downs
Phone: 5-8721

Fort Worth, Texas
3821 Carolyn
John M. Turbitt
Phone: FOrtune 4369
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Room 301-02 Wilson Bldg.
Roy D. Bagaley
Phone: 4-0366

Jackson, Mississippi
781 Raymond Road
George E. Akerberg
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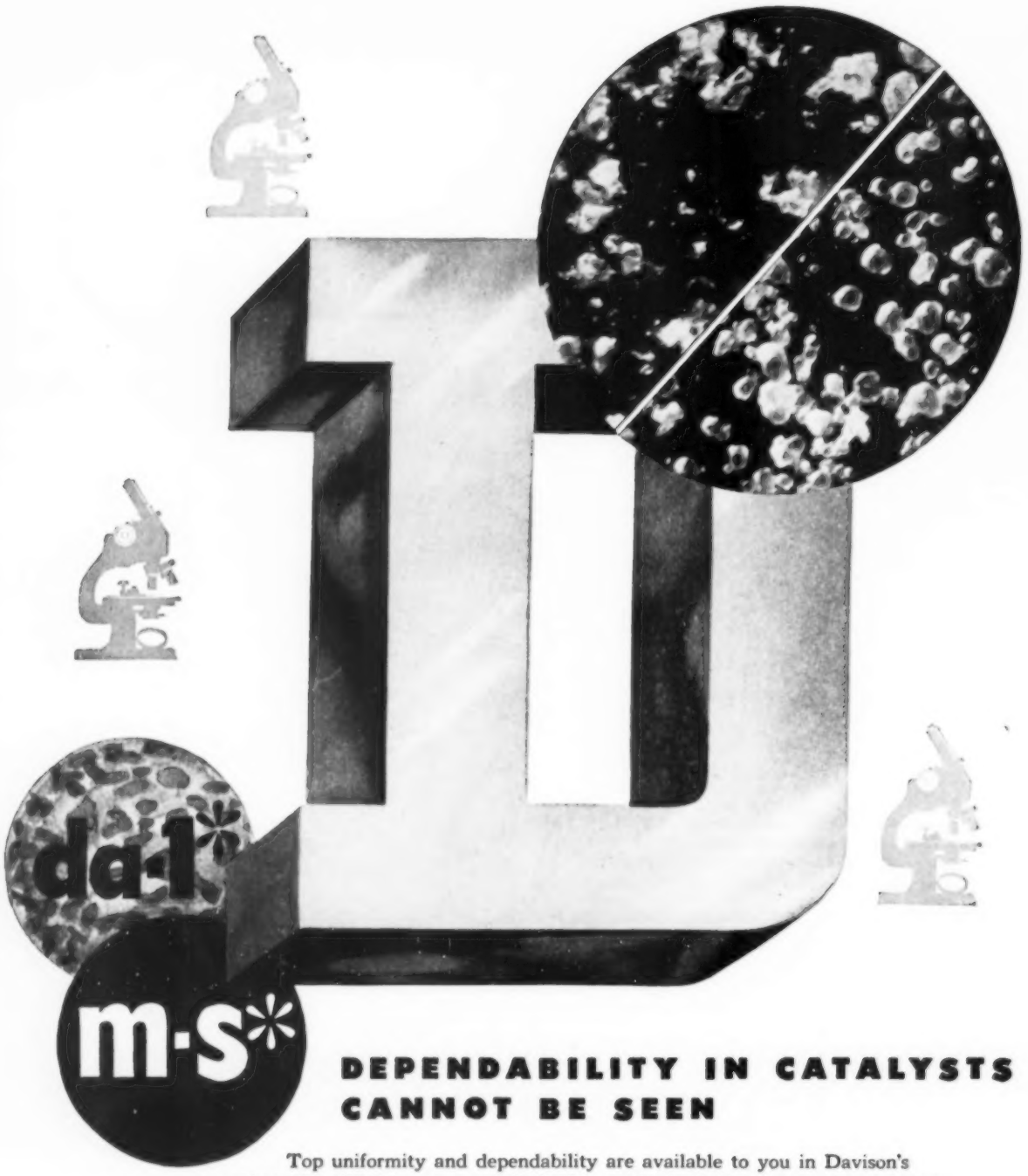

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Top uniformity and dependability are available to you in Davison's microspheroidal (M-S*) or ground (DA-1*) synthetic fluid-type cracking catalysts. The accompanying photomicrographs show the physical characteristics of the DA-1 and new M-S catalysts produced in Davison's Cincinnati plant. Uniform physical and catalytic characteristics result from Davison's modern facilities and years of technical experience and research. Experienced Davison Field Service Engineers—complete laboratory facilities—are all part of Davison Dependability—Dependability with the big "D".

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tary and assistant treasurer, and Nichols, controller.

Notice of Krumhansl's retirement was made in order to facilitate the taking over of new duties by other officers.

Snap-Tite Appoints Gulf States New South Texas Representative

Gulf States Distributing Company, Houston, has been made sales representative for Snap-Tite, Inc., Union City, Pa. President of Gulf States is Robert H. "Bob" White, who has over 17 years sales experience in related fields.

White

Gulf States has an exclusive franchise on Snap-Tite products for the southern part of Texas, or the territory south of a line drawn roughly from El Paso to Saline. Gulf States was organized in 1952.

Rockwell Sales Engineers Take Course on Natural Gas Problems

Two Rockwell Manufacturing Company sales engineers have completed courses in natural gas transmission and distribution at the Institute of Gas Technology, Chicago, Ill. They are Harry J. Schneider of the firm's New York district office and Harry Moore of the Columbus, Ohio, office. This is the second year that Rockwell representatives have attended the refresher course.

Koppers Plans Construction of New Development Unit at Kobuta

Koppers Company, Inc., will build a plastics development plant at the site of its large Kobuta, Pa., chemical plant. The new facilities will produce semi-commercial quantities of a wide variety of new plastics.

Design and erection of the new facilities will be done by the Chemical and Gas department of Koppers Engineering and Construction division, which built the original Kobuta installation for the government during World War II.

Central Scientific Division Adds Ewing as Research Chemist

Galen W. Ewing has joined Central Scientific Company's Research and Engineering division as a research chemist working in the field of instrumentation for chemistry. He is dividing his time between Cenco and advanced study at the University of Chicago while on sabbatical leave from Union College, Schenectady, N. Y. He is an associate professor of chemistry at Union College, specializing in instrumental analysis.

Peabody Promotes William Lange To Assistant Chief Engineer

William F. Lange has been promoted to the newly established post of assistant chief engineer at Peabody Engineering Corporation. Lange, who was for six years a field engineer with a firm of naval architects on the application of electromechanical devices, joined Peabody in December, 1946, as a design engineer in the application of high pressures for combustion of fuel oils in public utility and industrial plant steam generation.

Kieley & Mueller Moves Lieblich To Post of General Sales Manager

Appointment of Norman Lieblich to general sales manager of Kieley & Mueller, Inc., has been announced.

Lieblich

Lieblich, a licensed professional engineer, holds degrees from Polytechnic Institute of Brooklyn and from Stevens Institute of Technology. He was formerly chief application engineer of Kieley & Mueller and, until his recent appointment, held the post of assistant sales manager.

Benjamin Foster Expands Plant And Laboratory at Philadelphia

Benjamin Foster Company has completed construction of new general offices at its present plant site in Philadelphia, providing 1500 square feet of additional laboratory space for research and development projects. The company also recently built new fireproof quarters to house a section of its compounding and filling departments; this plant increases Foster's capacity by 20 percent. Miller-Myers were engineers, and Fleming Company, general contractors.

American Meter Subsidiary Builds Larger Facilities at Edmonton

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has constructed a new building in Edmonton, Alberta, as part of the general expansion program launched several years ago by American Meter. The new facilities provide a meter-run fabrication department and repair shops for displacement meters, orifice meters and control instruments as well as space for warehousing the company's complete line.

St. Hilaire Will Direct Sales In New Graver Construction Post

Appointment of Frank D. St. Hilaire to general sales manager, Graver Construction Company, a division of Graver Tank & Manufacturing Company, Inc., has been announced. Formerly with Trinidad Leaseholds Limited, The Texas Company and The Lummus Company in refinery engineering, plant operations and technical sales, St. Hilaire joined Graver in 1950 as chief engineer on its Tapline project in the Middle East. In his new post St. Hilaire will direct and coordinate national and international sales.

St. Hilaire

Cochrane, King and Sawyer Elected New Directors at Babcock & Wilcox

Stockholders of The Babcock & Wilcox Company have voted to increase the number of directorships of the company from 8 to 11. Elected to fill the newly created posts were Edward L. Cochrane, J. H. King and Luke E. Sawyer. Present directors reelected at the same meeting were A. G. Pratt, E. G. Bailey, Alfred Iddles, Paul D. Merica, C. W. Middleton, Stoddard M. Stevens, B. A. Tompkins and John C. Traphagen.

Cochrane, vice admiral USN retired, is dean of engineering at the Massachusetts Institute of Technology. King is a vice president of Babcock & Wilcox in charge of its Boiler division. Sawyer, also a vice president, is in charge of the Tubular Products division.

The board of directors later announced the election of two new vice presidents. M. Nielsen, an assistant vice president, manufacturing department, has been placed in full charge of this department of the Boiler division. W. H. Rowand, chief engineer of the Boiler division, will continue to hold the post of divisional chief engineer. Nielsen has been with B&W since 1924, Rowand since 1929.

At the same time the company announced several changes in its Refractories division:

J. E. Brinckerhoff, formerly sales manager of this division, has been advanced to general manager.

C. L. Norton, Jr., formerly technical director, will become executive assistant in charge of all development and engineering activities.

Carl Claus, formerly superintendent of the Augusta works, will become executive assistant in charge of all sales and manufacturing operations.

J. D. McCullough will continue as chief engineer in charge of engineering, service and application, with additional duties.

Mark J. Terman, formerly district

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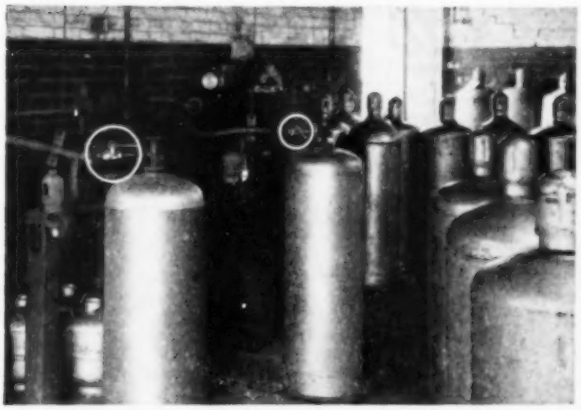
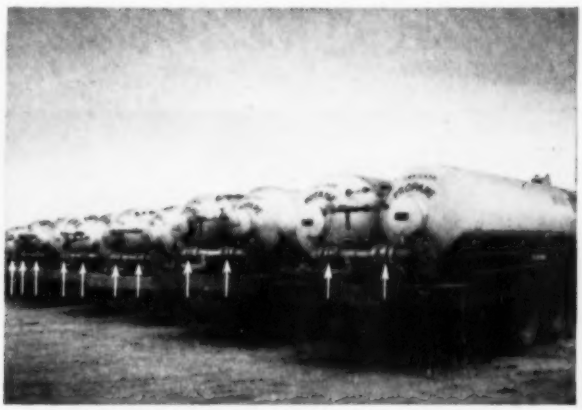
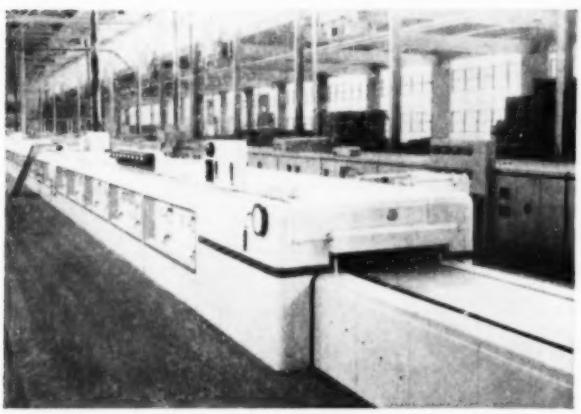


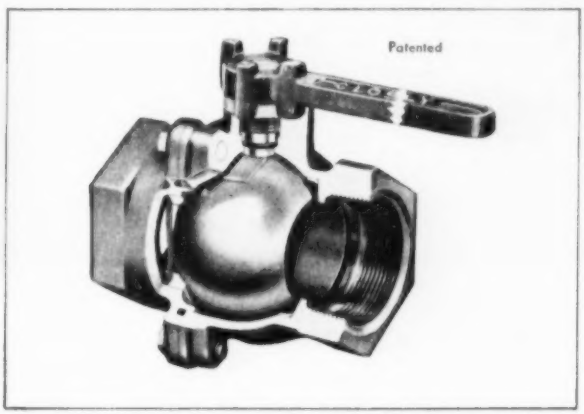
Leakproof in a Propane Plant, where hazards are high and protection is important. Here Rockwood Ball Valves are "far ahead of any others we have used," to quote the maintenance engineer.



Leakproof on LP Gas Trucks, where a whole fleet of trucks carries flammable bottle gas. Operator of fleet reports longer life for valves and generally lower costs since standardizing on Rockwood Ball Valves.



Leakproof in a Bakery where escaping gas and gas odor are a hazard. Rockwood Ball Valves, used in the ovens above, hold tight despite adjustment at various times to control flow of natural gas.



Leakproof for Longer Time — because Rockwood Ball Valves are designed to operate under the roughest and most grueling of conditions. They pay for themselves over and over wherever they are in service.

Plus these other exclusive features

Full Round Flow — assuring fast, efficient operation, less friction loss.

Quick Opening and Closing — needs only ¼ turn even under full pressure.

Resists Wear Longer — Chrome-plated bronze ball stands up under abrasion, pitting and scratching.

Rockwood Ball Valves are used in all types of applications throughout the petroleum field. Perform with trouble-free continuity. Longer time between replacements, less maintenance on the job. Comes in all pipe sizes. Tested and listed by Underwriters' Laboratories, Inc. The coupon will bring you complete information.

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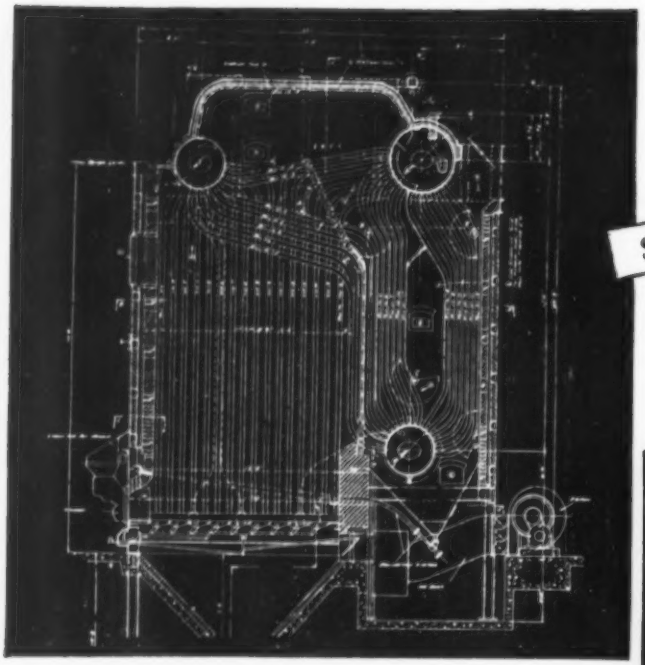

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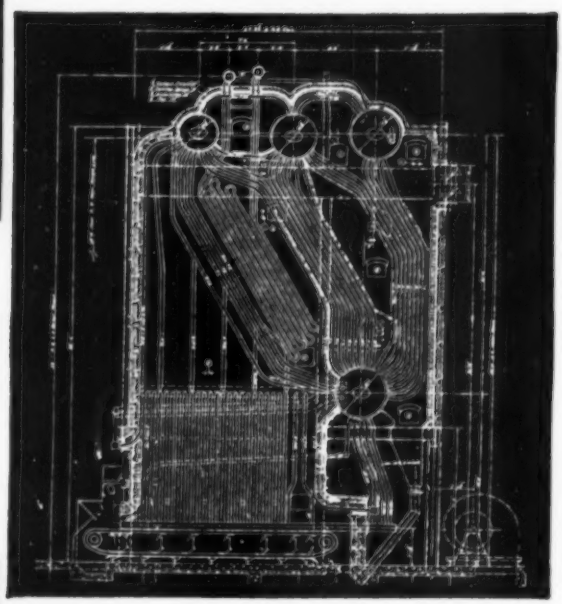
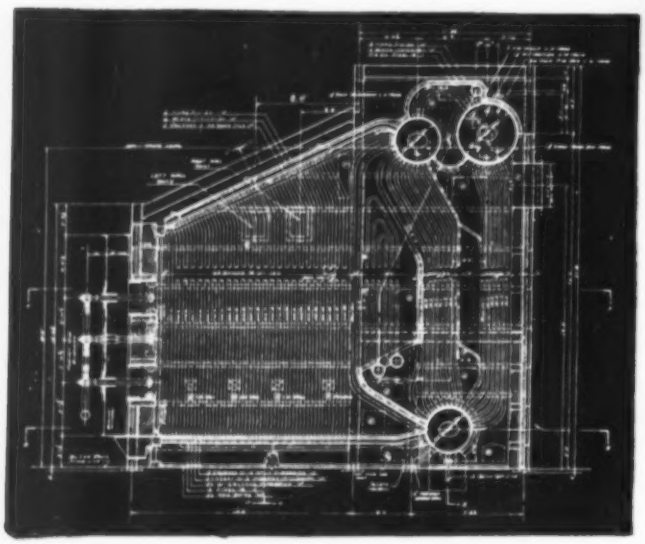


CLASS VL Two 27,500 pounds per hour units, installed at Brown-Forman Distillers Corporation, Louisville, Ky. Features large furnace volume in limited space, with high ratio of radiant heating surface.

CLASS LE Mt. Carmel Public Utility, Mt. Carmel, Illinois, is served by this 60,000 pounds per hour unit. Generous steam liberating surfaces and steam space permit wide fluctuations in load.

CLASS VR 70,000 pounds per hour steam generator at Humble Oil and Refining Company, Johnsue, Texas. An efficient, high-duty unit with water cooled furnace, using refinery gas fuel.



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manager of the Pittsburgh office, will become sales manager.

Bradford Hooper, formerly assistant to Norton, will become technical director.

Royce K. Mack, formerly assistant to Claus, will become superintendent of the Augusta works.

In another move, Babcock & Wilcox placed C. H. Gay, vice president and formerly head of the manufacturing department of the company's Boiler division, in charge of a newly established Atomic Power division.

Blaw-Knox Announces Election Of Rodgers to Vice President

Election of William Rodgers as vice president and general sales manager has been announced by Blaw-Knox Company. Rodgers joined the company April 1, 1953, in the new staff post of general sales manager.

Rodgers

The company also announced the appointments of M. R. Wingard and E. P. Addition as sales engineers in its Chemical Plants Division. Wingard will be located at the Western headquarters in Tulsa. Addition at the Pittsburgh office. Both men will offer the company's processes and engineering construction services to industrial clients in their respective areas.

Eversole Receives Appointment As Vice President of Bakelite

Appointment of Dr. James F. Eversole as vice president in charge of research at Bakelite Company, a division of Union Carbide and Carbon Corporation, has been announced.

Dr. Eversole joined Union Carbide in the research organization of Carbide and Carbon Chemicals Company at Niagara Falls as a research chemist in 1929. Several years later he was assigned to the laboratories of Linde Air Products Company, a division of Union Carbide. He became in 1951 manager of research administration of Union Carbide and Carbon.

Sinclair Signs Lease in Move To Consolidate Central District

Sinclair Refining Company has signed a 25-year lease for 150,000 square feet of space in the new 10-story, fully air-conditioned office building now being constructed by Suffolk Corporation in Chicago.

The new structure, first new office building to be erected in the Chicago Loop area since the 1930's, will be known as the Sinclair Oil Building and is due for completion prior to June 30, 1954.

The new building will enable the oil company to consolidate its Central district sales and other personnel, numbering about 800, in one location.

Colorado Fuel and Iron Opens $30 Million Seamless Tube Mill

Colorado Fuel and Iron Corporation's new $30 million seamless tube mill at Pueblo, Colo., has been officially opened. It is the first mill west of the Mississippi River.

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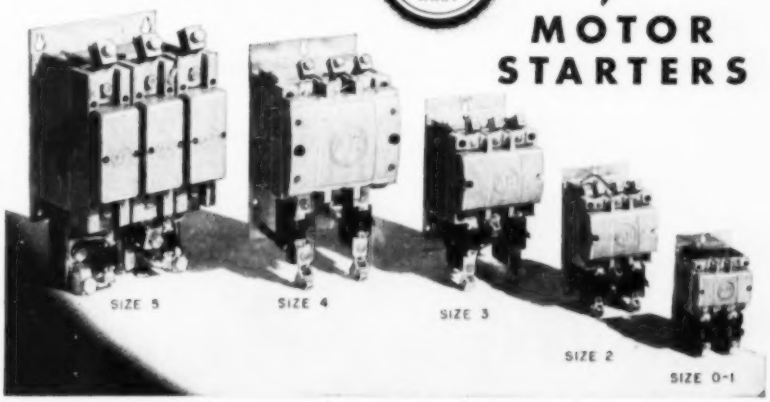

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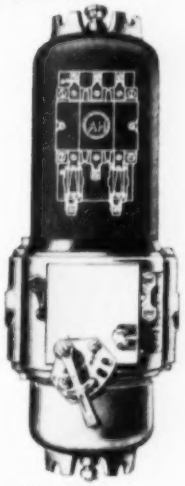

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The Houdry Dehydrogenation Process is applicable also to the production of propene from propane, isobutene from isobutane, styrene from ethyl benzene, and methyl styrene from isopropyl benzene.

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more than ten acres under one roof, including billet yard and pipe storage. When full production is reached, the mill will turn out over 150,000 net tons of seamless pipe a year. Construction of the new mill started in February.

Thurston Receives Appointment as Selas Cleveland Representative

Selas Corporation has announced the appointment of Thurman G. Thurston as its representative in the Cleveland, Ohio, territory. Thurston is a native of Cleveland.

Thurston

Educated at Case Institute of Technology, the new Cleveland representative served with the U. S. Army Signal Corps in the South Pacific during World War II. Immediately prior to his Selas appointment he served as a development and sales engineer for Bryant Industrial Division. Thurston will have his office at 1241 Commonwealth Avenue, Cleveland.

Kinder, Lemon and Cleminshaw Receive Appointments at Carlon

Carlon Products Corporation has appointed Ivan P. Kinder field engineer to specialize in Carlon plastic pipe applications in the petroleum industry. Kinder was formerly with Green Contracting and Engineering Company, Wichita, Kan.

At the same time, Carlon appointed Clifford L. Lemon and James D. Cleminshaw sales representatives in the Southwest territory. Lemon formerly represented Carlon in the East and will now be responsible for Carlon sales in South Texas and Louisiana. Cleminshaw, previously associated with Carlon at the Cleveland general offices, will cover North and West Texas, Oklahoma and Arkansas.

Allis-Chalmers Names Lory to Texrope Drive Section Position

Dwight H. Lory, former assistant to the general manager of the Norwood plants of the Allis-Chalmers Manufacturing Company, has been named assistant manager of the Texrope Drive section, located at the company's Plant #2.

Lory joined Allis-Chalmers training course for graduate engineers in June, 1942. In December, 1943, he was assigned to the Basic Industries department of the West Allis Works. He was promoted to assistant to the general manager at Norwood in June, 1951.

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EQUIPMENT INSPECTION ENGINEERS
SOUTH AMERICA

A major oil company affiliated with Standard Oil Company (N.J.) needs graduate engineers with several years refinery process equipment inspection experience. Must be qualified to interpret codes and specifications, predict equipment renewals, and recommend replacement equipment. Write, giving age, marital status, education, and full details of experience.

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DEVELOPMENT ENGINEER

Some graduate study preferred and 6-8 years experience in petroleum, chemical, power or allied fields of plant design. Permanent position on the East Coast with an organization known throughout the world for important contributions to the oil and chemical industries for a graduate ME or ChE. High salary and excellent opportunity to advance as our organization continues to grow. Other employee benefits such as insurance and pension plans are unusually generous. Please reply giving initial salary requirements and include information on education, background, experience and initial salary desired. Traveling and moving expenses will be paid. Box 169-R, c/o Petroleum Refiner, Houston, Texas.

POSITIONS WANTED

CHEMICAL ENGINEER — Broad experience, refinery operations, maintenance, process, construction, sales and market analysis. Desires administrative position in expanding oil or chemical company or as equipment manufacturer's sales representative. Graduate registered engineer, age 46. Southwest location preferred. Box 168-R, c/o Petroleum Refiner, Houston, Texas.

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U. S. Steel Division Names Link Director — Facilities Planning

Fred E. Link, assistant to the president of United States Steel Corporation's Oil Well Supply Division, has been appointed director—facilities planning. In his new position, Link will be in charge of general administration of the facilities planning policies of the division. His responsibilities will be concerned with the planning of new construction; installation, repair and replacement of buildings and machine tool facilities; letting of contracts for new construction and alterations and for property and equipment; and recommendations and approvals concerning appropriations for facilities and tools. He joined "Oilwell" in January, 1946.

Texas Firm Named A-C Distributor

The Lubbock Electric Company, Lubbock, Texas, has been named a distributor for Allis-Chalmers Manufacturing Company motors and controls in the Lubbock area. Paul V. Bush is owner of the Lubbock firm, which was established in 1944.

Fischer & Porter Executive Dies in Pennsylvania at 39

John O. Larson, director and executive vice president of Fischer & Porter Company, died recently at Hatboro, Pa. He was 39. He also served as a director of Fischer & Porter (Canada) Ltd., and of Alloy Steel Casting Company, and was widely known as a specialist in industrial instrumentation.

Larson

Larson had previously served as the company's sales manager and as manager of its sales and engineering office in New York. During the war, he served as an industrial instrument specialist with the War Production Board, spending considerable of his time in Washington.

Johns-Manville announces the development of new **SIL-O-CEL 16L** *Insulating Fire Brick . . .*

Lompoc, California, where Johns-Manville mines and processes diatomaceous silica insulating materials

Combines outstanding physical and thermal properties for furnace service to 1600F

Check these properties of SIL-O-CEL 16L

Maximum service temperature	1600F, back-up or exposed
Approximate density	33-35 lb per cu ft
Transverse strength	60 psi
Cold crushing strength	350 psi
Linear shrinkage	0.7 percent at 1600F
Reversible thermal expansion	less than 0.1 percent at 1600F
Thermal conductivity (Btu in. per sq ft per F per hr at indicated mean temperatures)	0.92 at 500F 1.07 at 1000F 1.22 at 1500F

1—has less than 0.1% reversible thermal expansion at 1600F

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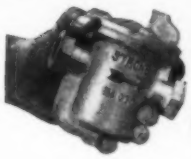

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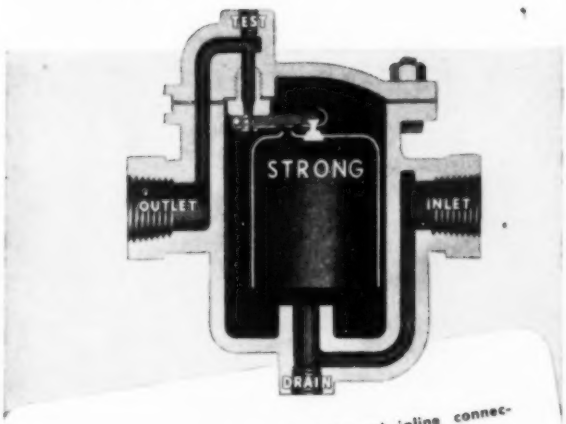

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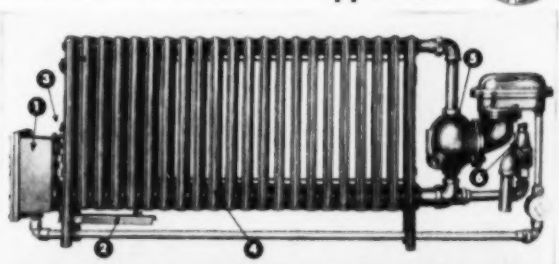

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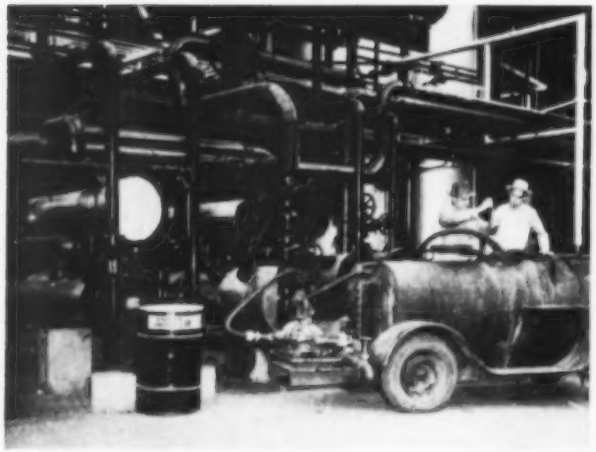

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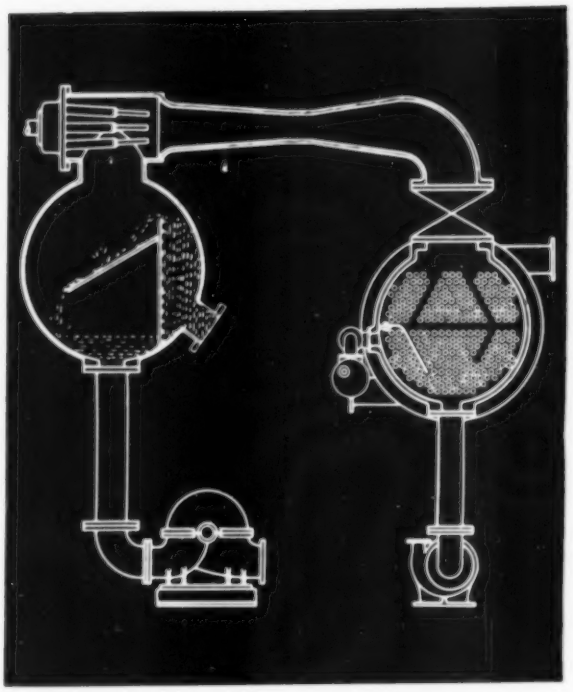

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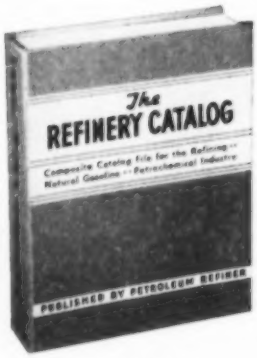
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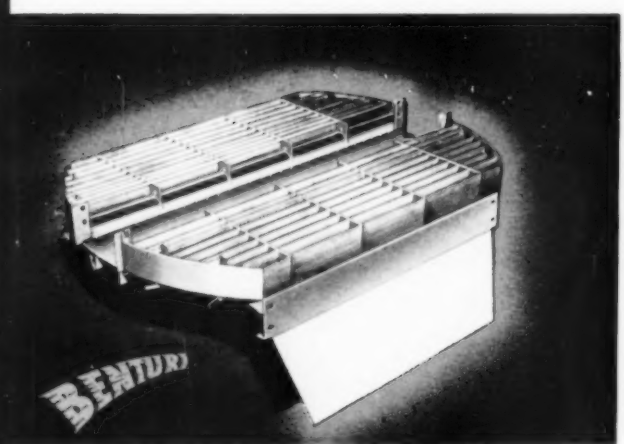

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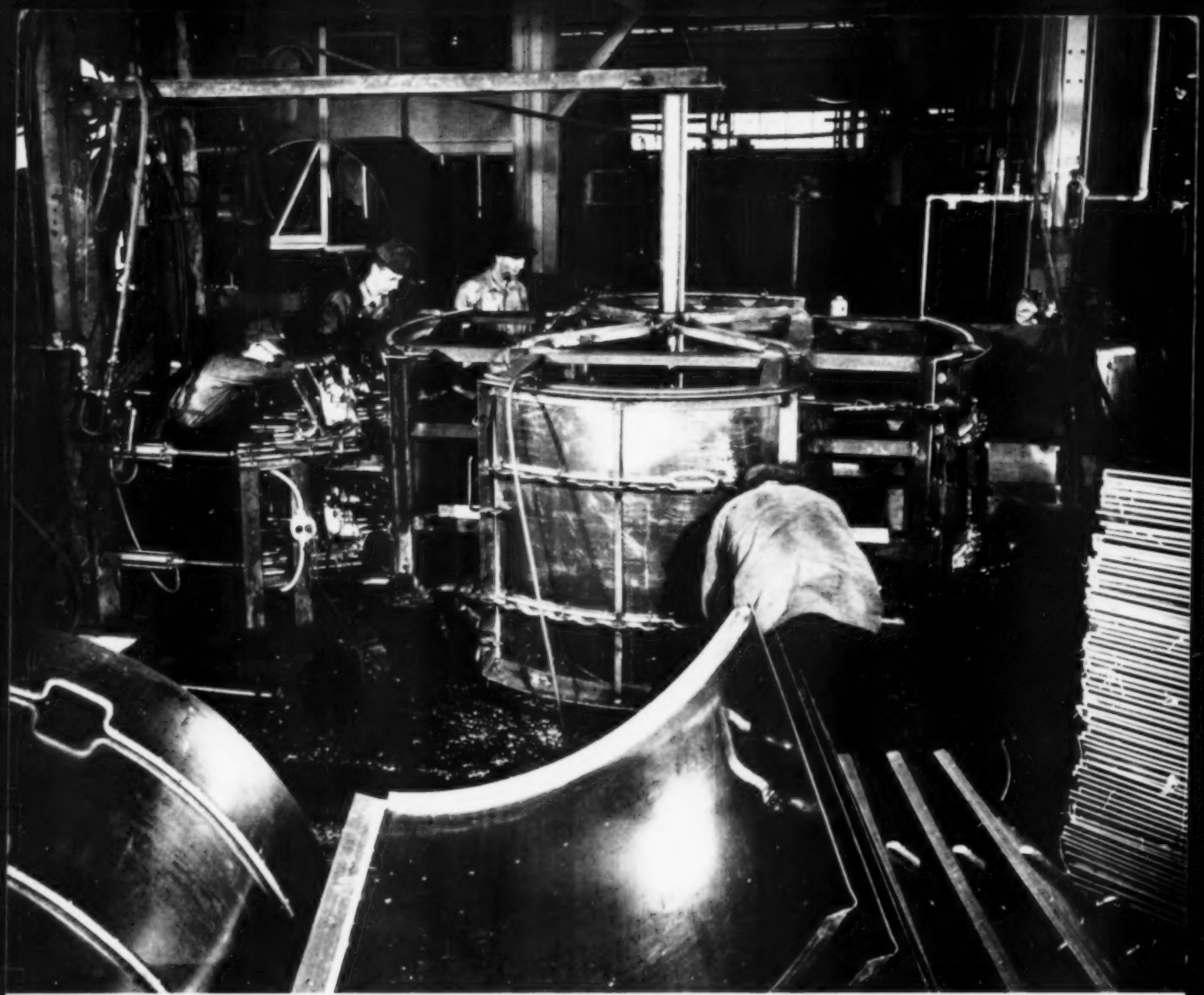

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